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Seed production research!

Editor's note: While the Southern hemisphere is preparing for the harvest, in the North, December brings the snow. This issue of the IHSG newsletter has articles investigating pre- and post-mown desiccation of ryegrass and tall fescue and the effect on seed yield and quality, a look at Lanzhou University's CPAST team, plantain seed production in New Zealand, red clover seed production in Europe and an update on the 2013 conference workshop. This is issue number 46 of the newsletter. Details of the contact person in your area are listed on the back page of the newsletter and on the IHSG website http://www.ihsg.org/. Please continue to send articles, updates or short papers to your area contact person to be included in future newsletters.

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Contents

President's Column

Welcome to the 46th edition of the IHSG newsletter. December is the month, where we in the northern hemisphere are 'closing down' yet another growing season.

At our institute we have the tradition to prepare a yearly report for the seed grower advisors in order to provide them with the results of the seed production experiments. The growing season 2010/2011 has been extreme – in particular with heavy rains in July and August, when the grass seed crops were ready for harvest. In this short period, where farmers are supposed to harvest the benefit from all their efforts in the field, any experience to assist in a wet season harvest is of interest.

This issue of the newsletter brings interesting results and experience from the application of desiccants to perennial ryegrass, Italian ryegrass and tall fescue. I'm sure this will be of interest to many readers. Please, keep sending input for the newsletter, and I would also like to bring to your attention that the IHSG webpage has facilities for IHSG-members to upload information about published papers (http://www.ihsg.org/view/publications). Since we don't have a specific journal for papers in seed production research, it would be really good, if information was given on the IHSG homepage.

In addition I would like to remind you to keep your contact information updated in the member list (http://ihsg.org/view/gmap). With the workshop coming up in 2013 we will use the member list to distribute information. Please also use the facility 'sort by country' and help us to keep the list updated.

As you'll see the planning of the IHSG-2013 workshop has already started, and Phil Rolston is asking for your feedback. The most recent workshop was held in Winchester in 2005 organised by Athole Marshall and colleagues in the UK. The IHSG workshops are usually held in conjunction with the International Grasslands Congress (IGC) every four years. But following the IGC in Ireland in 2005, it took place in Inner Mongolia in 2008 together with the International Rangeland Congress, just one year after the 7th IHSG conference in Norway.

I hope that many of you will join the IGC in Australia, 2013 and participate with papers or posters. I'm sure there will be several sessions of common interest to grassland and seed production scientists as for example: Advances in grass and forage physiology, understanding stress physiology of grasses and forages etc. From the IGC in Sydney IHSG delegates will fly to Christchurch for a 4 day workshop in the major seed growing area of New Zealand. The program is still open – so send you ideas and comments to Phil.

I would like to thank you all for the collaboration in 2011, and I wish you all a happy 2012.

President
Birte Boelt

Effects of pre-harvest desiccation with glyphosate and paraquat on Italian ryegrass and tall fescue seed quality

Bazzigalupi, O., Dell'Agostino E., Font A., Aquilano C

Summary

Seed harvesting is a major problem in the production of certain grass seeds. Selecting an optimum harvest date is difficult due to the lack of uniformity of maturity and the shattering of seeds. Chemical crop desiccation is often desirable to hasten maturity which would promote earlier harvesting and reduce losses of seeds. The objective of the experiment was to evaluate the effect of glyphosate (at 3 L/ha) and paraquat (at 2 L/ha) on the quality of Italian ryegrass and Tall fescue seeds from pre-harvest field-treated plants. Application of both glyphosate and paraquat at or after seed physiological maturity did not affect seed weight, but reduced seed quality (standard seed germination test) due to the increase of abnormal seedlings and dead seeds. Glyphosate and paraquat are not recommended as a desiccant in Italian ryegrass and Tall fescue seed production.

Bazzigalupi, O., Dell'Agostino E., Font A., Aquilano C., 2011. Efectos de la aplicación de glifosato y paraquat, en precosecha de raigrás anual y festuca alta, sobre la calidad de la semilla. *Análisis de Semillas*. 5 (18):53-57

Use of desiccants on mown ryegrass as a wet season harvest aid

Phil Rolston[1], Murray Kelly[2] and Richard Chynoweth[3]
[1]AgResearch Lincoln, [2]PGGW Seeds Kimihia, [3]Foundation for Arable Research, Lincoln

Summary
Three desiccants were applied to mown ryegrass (Samson) in the swath that had regrowth grass to evaluate if they would enhance harvesting and to determine the effect on seed quality. Diquat (Reglone), Buster and glyphosate 360 were all applied at 2.5 L/ha on 13 Feburary and combine harvested 6 days later. There was no effect of treatments on seed quality measured as emergence in peat-sand trays or on germination, seed yield or dressing out percent. At combine harvest the operator rated the ease of harvest as Diquat > Buster > glyphosate > nil.

Introduction
In years with wet weather at harvest, re-growth of ryegrass through the swath becomes an issue. The question 'can re-growth be desiccated?' is often asked. Previous work in the United Kingdom has evaluated diquat and glyphosate as a pre-harvest desiccant for direct heading. In perennial ryegrass with two cultivars, Roberts & Griffiths (1973) reported a high percentage of abnormal and low germination rates when diquat was applied and the crop harvested two to nine days later. When glyphosate, at rates of 1.0 and 2.0 *l*/ha (480 and 960 g ai/ha) was applied at either 40 or 34% seed moisture content and direct headed 14 and 11 days later respectively, both these treatments reduced germination from 89% to 75-79% and increased abnormal from 2.3% to 10+% (Hampton & Hebblewaite 1983). It was recommended that glyphosate should not be used as a pre-harvest desiccant. In light of these results the use of diquat and glyphosate as a desiccant to control re-growth has not been recommended (in New Zealand). This trial reports on an experiment to investigate if re-growth can be desiccated post cutting, but pre pickup, without reducing seed quality.

Method
Samson perennial ryegrass (*Lolium perenne*) that had been in a mown swath for four and a half weeks with significant regrowth (Figure 1) was sprayed with either Reglone (diquat 200 g ai/*l*), glyphosate (360 g ai/*l*) or Buster (glufosinate-ammonium 200 g ai/*l*) all applied at 2.5 *l*/ha with 250 *l*/ha water. The trial was located on the headland of a commercial seed crop at the Plant and Food Research Centre. The treatments were replicated four times in a randomised block design with plots that were 2 x 9 m. Six days after treatments
were applied the plots were machine harvested using a plot combine, dressed by hand sieving and blowing with the dress-out % and seed yield per plot calculated. Germination was assessed on bulk samples by AsureQuality Seed Testing Laboratory. Also for each plot 120 seeds were sown in July in sand-peat mix trays and the number of emerged seedlings assessed at 14 days.. The germination tests were repeated in December, 10 months after harvest.

Results
There was no effect of any treatment on final machine dressed seed yield ($P<0.05$). Seed yields are lower than expected due to increased time spent in the swath and possibly the location on a headland. There was a very visual effect of desiccation by all treatments just prior to harvest (Figure 2). There was no effect of the desiccant treatments on seed quality including germination (and no abnormal) and emergence (Table 1). The seed yield was low, but not affected by treatments and the dressing out percent was also similar between treatments (Table 1). The plot combine operator assessed the ease of pickup (pea lifters) and threshing (amount of machine vibration) in the following order of easiest to hardest to harvest: Reglone (diquat) > Buster (glufosinate-ammonium) > glyphosate > nil.

Table 1. Harvest and post harvest data for three post cutting desiccant treatments, germination and endophyte levels tested six months post harvest, cultivar Grasslands Samson

Treatment	Germination (%)		Seed Yield (kg/ha)	Dress-out (%)
	6 day	14 day		
Nil	98	98	830	52
Reglone (diquat)	96	96	740	52
Glyphosate	96	96	940	55
Buster (glufosinate-ammonium)	97	97	950	53
LSD 5%			NS	10
F prob			0.65	0.81

At 10 months after harvest no difference in seed germination was recorded between any treatments (table 2).

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Table 2. Germination (%) for four desiccant treatment 10 months after harvest

Treatment	Germination (%)
Nil	94
Reglone (diquat)	96
Glyphosate	93
Buster (glufosinate-ammonium)	95
LSD 5%	4

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Acknowledgements

FAR wishes to thank AgResearch, Plant and Food, and PGG Wrightson for their contribution to these results.

Figure 1. Trial site before desiccants were applied

Figure 2. Treatments six days after application, from (L) to (R) 1. glyphosate; 2. Reglone (diquat), 3. Buster (glufosinate-ammonium) and 4. nil

Plantain (*Plantago lanceolata*) Seed Production in New Zealand – Lessons in Development of a New Crop

Murray J. Kelly, PGG Wrightson Seeds, Christchurch 7640, New Zealand

Abstract

Plantain (*Plantago lanceolata* L.) has been developed as a pasture herb, sown as either a companion species with grass, clover and other herbs, or as a dominant species in specialist pastures. Two bred cultivars were introduced to the New Zealand forage market simultaneously in 1995 and have developed markets in both New Zealand and Australia. Rapid uptake of new technologies and agronomic techniques have improved seed yields from an average of 300 kg ha^{-1} in early productions to 1,600 kg ha^{-1} in 2008, an increase of 433%. The tonnage produced over these 10 years totals 1,282 MT.

Key words: crop agronomy, plantain, seed yield

Introduction

Plantain was a common pasture component in temperate European climates some 200 years ago, prior to the development of intensive ryegrass and clover based pastures. In New Zealand its potential role was investigated again from the late 1970's and new cultivars Grasslands Lancelot and Ceres Tonic were released collaboratively in 1995. Lancelot was bred from selected local collections and Tonic from selected Mediterranean germplasm providing different seasonal production patterns and levels of forage production. Over two years the forage production level in Canterbury under a low irrigation regime was shown to be within 5% of perennial ryegrass (Stewart 1996, Rumball et al. 1997).

The seasonally longer and higher total production level of Ceres Tonic has been recognised and this cultivar dominates seed production area with approximately 95% of the area (Anon. 2010). Agronomic testing and market development initially concentrated on its role in pasture mixes with commonly used species such as ryegrass, clover and chicory; control of common weed species in these mixtures; adaptability to climate & soil range; grazing animal effects. As climate zone adaptivity and animal performance data, notably sheep, became more understood it has resulted in the development of specialised intensive pastures with plantain as a dominant component. (Moorhead et al. 2002, Judson et al. 2002).

Development of Plantain Seed Production

Seed production research was initially undertaken at DSIR Grasslands (now AgResearch) where the roles of nitrogen, timing, plant density, closing time, harvest time and seed loss were explored. The effects of harvest time and seed loss were identified as major factors (Rowarth et al. 1993) and remain as key issues. Following initial research station productions the first field productions for commercial seed were sown in March 1994 and harvested in January 1995. Initial yields were similar to that achieved in research trials.

In parallel with market development, PGG Seeds continued seed production trials and extended this information with intensive advice and monitoring of the grower group. Key factors in achieving crop hygiene and quality standards for markets were essential issues initially, followed by assessments of crop risks and yield losses and then undertaking agronomic studies to improve seed yields. These trials were placed in seed growers' fields who actively participated in discussions to solve agronomic issues as they arose.

Risk of crop failures was mitigated by selecting and inviting innovative growers with known high standards of seed production and by a geographical spread of crops around Canterbury, New Zealand to avoid concentrated climate events. Both latitude (43.6 – 44.6°S) and altitude (from sea level to 300m asl, approximately 60 km inland) provided a geographical spread over a range of about 5,000 square kilometres. Over time the value of irrigated crops also became apparent. The existing growers took all available crop area so that a core group of experienced growers was conducting all the production with close direct contact between research agronomists and seed growers.

Concurrent Seed Production Research - The Lessons

Both reactive and preventative protection programs had to be quickly developed for a range of pests, diseases and agronomic issues:

Weed control programs took some time to develop to cover the wide range of arable weed and volunteer crop species. Smart herbicide programs developed into a key tool for crop

management. The place of plantain in crop rotation and use of weed control systems are now well understood.

Sowing time was found to be an important function of soil type and altitude (related to temperature). Plantain is susceptible to frost lift and some silt soil types are highly affected requiring early plant establishment, even in some coastal areas.

Some diseases can be extremely damaging to seed yield. Examples are *Ramularia rhabdospora* leaf spot in mild damp spring conditions and *Phomopsis subordinaria* stem choke in wetter conditions from flowering to cutting. Both protective & reactive fungicide programs have been developed to provide growers with options according to seasonal disease pressures.

Some pests are also infrequent serious problems. Slugs and the native New Zealand grass grub (*Costelytra zealandica*), a root feeding coleopteran larva can be serious even at low populations. Multi-year crops were found at serious risk to the native lepidoptera porina (*Wiseana cervinata*) and to the introduced weevil *Gymnetron pascuorum*, often called "plantain weevil".

Nitrogen input and crop closing time from grazing or defoliation were found to have large influence on yield potential and also needed to be related to herbicide withholding times.

High seed shattering can result in large potential seed losses. Establishing cutting time and techniques was based on experience with a range of grass seeds, but substantial differences were soon apparent. Plantain leaf does not readily wilt; both stomata function and anti-fungicidal properties are believed to play a role. Yet the shattering continues in the windrow and the *Phomopsis* stem choke continues activity restricting seed development. Larger windrows can capture more shattered seed within their bulk but can take 3-4 weeks to dry and are exposed to greater risk from weather events such as rain and winds. Techniques for chemical desiccation of leaf area and application of pod adhesives, combined with protectant fungicides, and timings both pre- and post-windrowing have been developed in conjunction with innovative seed growers.

The combination of small plot agronomic trials and adaption to large scale farm techniques has provided a steady improvement in seed yield that has overcome vagrancies of seasonal climatic variation, and provided the growers with tools for a reliable crop income.

Crop Area and Seed Yield 1998 to 2008

Both Grasslands Lancelot and Ceres Tonic have been grown under New Zealand PVR and Seed Certification schemes. Seed yield and area harvested are shown in Fig 1. Average grower seed yields have risen from 300 to 1600 kg/ha over 15 years. The highest commercial seed yield harvested was 2570 kg/ha.

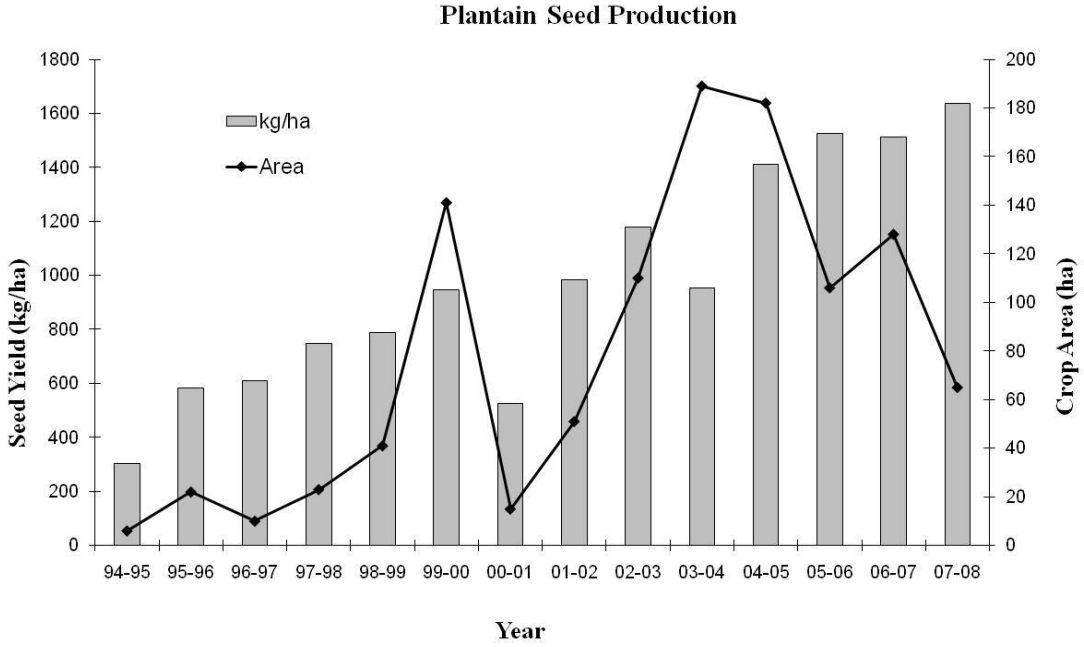

Fig. 1. Seed yield (kg/ha) and area harvested (ha) from 1994/95 to 2007/08.

Conclusion

The domestication of plantain from a weedy semi-prostrate herb to an erect leaved forage and the development of commercial seed yields is an example of the flow of research from the research station to on-farm trials and the value of innovative growers and seed company researchers developing production protocols.

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Plantain (*Plantago lanceolata* L.) in flower

Nordic seminar on Herbage Seed Production

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The Nordic Association of Agricultural Scientists organized the 15th seminar on Herbage Seed Production in Ilmajoki, Finland 28-29 June 2011. Markku Niskanen and Oiva Niemelainen were the local organizers, with 37 delegates from the Nordic countries Estonia, Finland, Norway, Sweden and Denmark participating. During the two day program various topics were discussed with reference to the specific conditions for herbage seed production in each country. Despite the remarkable climatic and agricultural differences one crop was represented by three of the five countries: Red clover.

IHSG-delegates visiting red clover crop in Norway

Bumble bee pollinating red clover. Photo: Ulla Andersen

Norway

Red clover is one of the most important forage legumes in Norway, where it is grown in mixtures with grasses. The annual seed production of red clover seed in Norway is approximately 100 tons – primarily from diploid varieties.

Helga Arndahl recently started her PhD-project focusing on the reasons for low seed set in tetraploid red clover. The investigations will be carried out in a field trial where seed yield components in a "high" seed yielding tetraploid breeding line, a "low" seed yielding tetraploid cultivar and a diploid cultivar are examined. Helga is employed by Graminor AS and studying at the Norwegian University of Life Sciences, in Ås, Norway.

Trygve Aamlid presented results from field experiments in 2007-09, where the effect of control of weevils in seed production of red clover was determined. The occurrence of red clover weevils (*Apion apricans, A. trifolii* and *A. assimile*) and the lesser clover leaf weevil (*Hypera nigrirostris* Fab.) was monitored in the major seed production districts in South East Norway. *Apion* seed weevils were found in all districts with an average frequency of 0.67 larva per flower head. Despite large reductions in the number of *Apion* sp. and *H. nigrirostris* larvae the average seed yield was positively affected in only two out of seventeen large scale trials. Test in small scale trials revealed that the neonicotinoide Biscaya 240 OD (tiachlorid) produced seed yields similar to unsprayed control whereas applications of the pyrethroid Fastac 50 (alphacypermethrin) mostly caused seed yield reductions. The general conclusion is that the experienced negative trend in red clover seed yield in Norway cannot be stopped by the use of insecticides, and it is speculated that inadequate frequency of pollinating insects may be the reason for the decline in red clover seed yields.

Sweden

Gunilla Larsson reported results from investigations in weed control in seed production of red clover. Traditionally Basagran (bentazon) has been used, but the herbicide is expensive, not always effective and there is an increased concern of the risk of residue leaching to ground water. In four trials in southern Sweden weed control by Reglone (diquat), Basagran and mechanical defoliation have shown that the application of Reglone may substitute Basagran and in places where the weed Matricaria is the major problem, defoliation at the end of May could partly substitute a chemical weed control. This strategy is already implemented by the organic growers of red clover seed.

Eva Stoltz and Ann-Charlotte Wallenhammar presented results from trials with soil and foliar application of boron to white and red clover seed crops in soils with low boron concentration (<1 mg B kg^{-1}). In red clover the results are based on two field experiments in central Sweden in 2009-2010 in cv. SW Nancy and SW Ares. Although not statistically significant seed yield improvements of 9% were registered after boron application.

Denmark

Traditionally red clover was one of the major seed crops in Denmark, however seed yield as well as production area has decreased. As opposed to white clover, the seed yield in organic grown red clover is at same level as the yield in conventionally grown crops. In 2006-08 experiments were carried out to monitor the effect of pest control on seed yield in red clover cv. Rajah. On average a significant seed yield increase was found when plots were systematically kept free from pests, but the effect varied from year to year. Recently we finalized a three year experiment where the effect of growth regulation by Moddus (trinexapac-ethyl) and spring defoliation was tested in order to reduce biomass. In dry years defoliation in mid to late May decreased seed yield and on average no significant effect was found from the use of Moddus.

Red clover seed yield in field plots is approximately 2.5 times that of practical seed grower fields in Denmark. Experiments with reduction of vegetative growth in spring, growth regulation and pest control could not explain this discrepancy.

Delegates relaxing at Finnish sauna.
Photo: Gunilla Larson

College of Pastoral Agriculture Science and Technology (CPAST)

Jason Trethewey, AgResearch Ltd, New Zealand

In September of this year I was fortunate enough to be invited to visit the College of Pastoral Agriculture Science and Technology (CPAST) at Lanzhou University, China. Located in Lanzhou, the capital city of Gansu province, Lanzhou University is one of the key universities under Ministry of Education, China. Occupying almost 4,000 acres at the upper stream of the yellow river, it includes 8 campuses and three affiliated hospitals. With over 25,000 undergraduate and post-graduate students, the university employs 4,000 staff, including almost 400 professors and 9 academicians of the Chinese Academy of Sciences and Chinese Academy of Engineering. Lanzhou University is one of the top ten universities in contributions to academic publications in international journals. The University has 25 schools and colleges.

Yellow river, Lanzhou

Water wheel park by yellow river, Lanzhou

One of these colleges is the College of Pastoral Agriculture Science and Technology (CPAST). The dean of CPAST is Professor **Nan** Zhibiao, Academician of Chinese Academy of Engineering, who spent three years at Massey University, New Zealand completing his PhD. The college is a centre for excellence that focuses on a wide range of research including pastoral agriculture, environmental modelling, soil erosion, water use efficiency, salt tolerance, endophyte, plant persistence, native grassland ecology and seed production.

My host was Director of Herbage Seed Science and Germplasm Professor **Wang** Yanrong. Professor Wang has also studied in New Zealand completing her MSc at Massey University. With a strong interest in seed science and technology in herbage crops, Professor Wang and her team investigate seed germination in Chinese native herbage species, seed vigour in small seeded herbage legumes, seed storage and deterioration in some herbage species, seed priming and seed production in several herbage legume and turf grasses.

During my visit I was fortunate enough to work with associate professors and post-graduate students at the college discussing seed production related issues. In addition, I was able to visit the main seed production area of the Gansu province in the Hexi corridor and visit the Lanzhou University Zhangye research station. Visiting the research station and meeting local farmers gave me the opportunity to understand seed production management practices in a village based seed production system. Another trip to a research station on the Tibetan border allowed me to view native grassland seed production research.

Arrival at Lanzhou University


Native grassland, Tibetan Plateau

During my visit I also gave several lectures to the post- and undergraduate students. Lanzhou University has a strong focus on international collaboration and information sharing. AgResearch in New Zealand and CPAST at Lanzhou, China have a long history of collaboration. Dr Phil Rolston at AgResearch in New Zealand has been involved in seed production technology transfer and rural agriculture extension work in China for 25 years. In 1996 he was awarded the Friendship Medal, for grassland work in the southwest Chinese province of Guizhou. He has visited Gansu and CPAST several times including in June 2011. Professors **Nan** Zhibiao and **Wang** Yanrong at CPAST have both studied in New Zealand and have continued to collaborate and host scientists from New Zealand Universities and research Institutes. Myself and Professor Wang will be working together in the future and collaborating on seed loss issues during seed production. I hope to visit the CPAST team at Lanzhou again in the near future and also get some of the CPAST team to New Zealand to work with our seed production team.

The seed production management and harvesting systems in New Zealand and China although very different also have some common issues especially around the area of seed loss and reducing this.

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Seed production trials, Tibet


Seed dressing the Tibetan way

International Grasslands Congress (IGC) Sydney (Australia) & IHSG Workshop (Canterbury, New Zealand)
September 2013

International Grasslands Congress (IGC) Sydney 14 – 18 September
Mark your calendar for September 2013 and make plans to attend the IGC Conference Sept 14th to 18th in Sydney, Australia. The IGC will include a Seeds Session. This will be followed by a 4 day IHSG workshop in the heart of the herbage and vegetable seed production region of Canterbury NZ.

IHSG Workshop , New Zealand 20-23 September 2013
While the venue for workshop is not confirmed we are looking at being based in Methven, a major seed growing locality and accommodation base for the Mt Hutt ski field. Methven is 90 km south west of Christchurch. It will be near the end of the ski season and the snow covered mountains behind the town will provide a great view.

Christchurch is a 3 hour flight from Sydney with several flights a day. Many people choose a late afternoon flight that arrives about midnight in Christchurch.
What will you see at the Workshop? We want to show you aspects of the NZ herbage seed industry that make it different to elsewhere; in September farmers will be grazing ryegrass seed crops with sheep (perhaps young cattle); see complex crop rotations that involve seed production of grasses, clovers, cereals, vegetable and forage brassicas, and carrots; remote sensing and GPS technologies for seed crops, variable rate irrigation systems, grass weed management in grass seed crops and inter-row spraying in clover. We want to have a "meet our seed growers" session.

The Local Organizing Committee is keen to have feedback from members on subjects they would like to have covered during the Workshop. Comments to Phil Rolston (phil.rolston@agresearch.co.nz).

8th IHSG Conference (early June 2015).
The IHSG members will vote in 2013 to confirm the venue for the next conference. I invite all potential candidates for the next IHSC to send further information. This information should be available before the next workshop in New Zealand 2013. At Dallas the Gansu Province (China) delegation offered Lanzhou City as the next venue for our conference. Phil Rolston visited Lanzhou University in early June this year and met with Prof. Wang Yan Rong and her team. They have good conference venue facilities and the University has plenty of experience in hosting International Conferences. There are good options for an excellent post conference field trip into the main seed growing area of China, the Hexi Corridor. Lanzhou City represents the Chinese end of the Silk Road which heads west through the Hexi Corridor. I think this will be an excellent venue for our next full conference.

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