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IHSG

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Research, workshops and the 8th IHSG conference!

Editor's note: Here in western Oregon we are experiencing typical winter conditions with cool wet weather and our seed crops are pushing through the seedling stage. Hopefully those of you in the southern hemisphere are gearing up for the end of the crop season and favourable harvest conditions are coming to fruition. In this issue, we focus on several very interesting research and workshop reports related to herbage seed production in both the southern and northern hemispheres. I encourage you all to review the information provided from our colleagues in China who are working very hard to plan for the 8th IHSG International Conference in Lanzhou in June of 2015. An interesting conference agenda relevant to a wide range of global seed production topics is proposed. Also, a very exciting post conference tour has been planned with the hopes that many of you can participate. Please check the IHSG website (http://www.ihsg.org/) for conference registration details in the near future. This is issue 51 of the newsletter. Lastly, please remember to send articles to either of the newsletter editors or to your area contact person to be included in future newsletters.

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Contents

President's Column

Welcome to the December 2014 Newsletter and a big thanks to Nicole Anderson as editor of Newsletter #51. My thanks to members who contributed to this edition and I encourage members to share a story about the seed industry in your region or a research outcome from your work in different corners of the globe.

Preparations for our 8th IHSG Conference in Lanzhou China during 22nd to 29th June are well underway. This is our first conference held outside the traditional large temperate herbage seed production areas of Europe, USA and Australasia and it is an important step in put a capital "I" in the international part of our name. We have had 72 abstracts submitted and this makes the conference presentations and posters larger than our previous conference 2010 conference in Texas. We welcome members' attendance to the conference. Conferences are not only an opportunity to share research results and ideas but also a time to renew friendships and for this conference to enjoy Chinese hospitality and culture. I have visited China more than 50 times in the last 30 years and never tire of the food, hospitality and culture.

Getting young scientists to our conferences is a challenge we need to meet, especially where international travel costs can be a barrier. Certainly we will see many young Chinese post graduate students at the Lanzhou conference. At our conference business meeting in Lanzhou, I hope to be able to share some ideas on how we can assist young scientists to attend our conferences.

In July I visited seed crops in Uruguay and Argentina. One the discussions I had was the differing rates of reproductive development for ryegrass and tall fescue that occur between South America and New Zealand. Cultivars that we harvest in New Zealand in mid January are harvested 3 weeks earlier there. This discussion led on to thoughts around temperature, heat units and radiation effects on reproductive development and seed development. In maize and a few other crops these relationships are well understood. However in herbage seed we have hardly scratched the surface on being able to model environmental effects on plant growth, especially in reproductive development. There is a collective challenge for us to be able to do this and a great opportunity for collaboration for groups in different environments and latitudes.

Wishing everyone a good Christmas-New Year and for those in the southern hemisphere a good harvest. See you in Lanzhou.

Phil Rolston
President

8th International Herbage Seed Conference 2015

YanRong Wang, Chairperson of Local Organizing Committee

The 8th International Herbage Seed Conference will be held in Lanzhou, Gansu province, China (Figure 1) from June 21 to 24, 2015. The conference will be followed by a 5 days post-conference tour to the Gansu Hexi Corridor (Silk Road). The conference local organizer is the College of Pastoral Agriculture Science and Technology (CPAST) of Lanzhou University.

Figure 1. Night view of Lanzhou city.

Herbage seed production in China

Demand for forage and turf grass seed in China has been increasing as required by grassland restoration and animal production. Currently about 150,000 tons herbage seed is sown annually, and the domestic production is only about 100,000 tons each year. Thus, nearly one third of the total herbage and turf grass seed sown in China is imported from other countries. The primary regions for herbage seed production are Gansu, Inner Mongolia and Qinhai. These 3 provinces located in northwest of China produce about 68% of the total seed produced nationally. Lucerne, oats, sudangrass, milkvetch, *Elymus nutance* and common vetch as the primary species produced and among these lucerne and oats rank at the top of domestic seed production. The main imported herbage seed species are ryegrass, fescue and bluegrass. The China herbage seed industry initiated in the late of 1980s and while progress is evident, the industry is still in the developing stage. Limitations for the herbage seed industry development in China include: weak support for herbage plant breeding programs, difficulty in maintaining new variety purity, and minimal adoption of applying research results being to actual seed production practices.

Host institution

Lanzhou University is a major university ranked the top 30 in China. The College of Pastoral Agriculture Science and Technology (CPAST) of Lanzhou University is one of the leading

institutions in the grassland science research and teaching in China. The main missions of the CPAST are: to carry out research for increasing agricultural productivity and land sustainability through integration of pasture, cereal and livestock production and to teach undergraduates and graduate students in grassland science and ecological science. There are approximately 50 academic staff, 357 undergraduates and 328 postgraduates in college. The CPAST is well equipped with advanced research facilities and has 6 research stations located different ecological zones within China. The primary research areas include: seed science and technology, plant breeding, forage plant pathology, turf science, integration farming systems, rangeland management, remote sensing and information technology and agriculture economics. An Official Herbage Seed Testing Center owned by the Chinese Ministry of Agriculture is also located in the college and recently became ISTA certified in 2014.

The research activities conducted by the herbage seed group primarily involve: seed testing technology, native seed production, seed biology and ecology, and selection for high seed yield forage varieties (mostly related to reducing seed shattering). Developing guidelines for testing distinctness, uniformity and stability for new herbage plant varieties is another important activity beyond the seed work. There are 10 staff and 15 post-graduate students working in this group. Since it was established in 1986, the Official Herbage Seed Testing Center has played an important role in mantaning seed quality standards in the northwest region of China.

Conference venue

Lanzhou (Figure 1) is the capital city of Gansu province in northwest China with a history of more than 2000 years, covering an area of 1632 km^2 with 3.6 million residents. It is the only city that the Yellow River runs through, allowing for production of many rich fruit crops. Lanzhou is the transportation and telecommunication hub for the region. The climate in June is very pleasant for visitors, with an average temperature of 20^oC and humidity of 54%.

Lanzhou is a hot spot on the ancient Silk Road which is abundant with tourist attractions. Along the banks of the Yellow River extends the longest riverside road in China, where you can admire the first bridge over the Yellow River, Watermill Park which has the sculpture of the Yellow River Mother, White Pagoda Park, and Five-Spring Mountain Park.

Post conference tour

The post-conference tour will visit the Hexi corridor, which consists of the main part of the ancient Silk Road. The region is primarily occupied by desert and Gobi. Several oases are formed along the inland rivers. The snow-capped Qilian mountains (Figure 2) lay to the south while the Mazong, Heli and Longshou mountains lay to the north. There are diverse landscapes and farming

Figure 2. Qilian Mountains

Figure 3. Alpine grassland-yak system

systems in the Hexi Corridor which include: alpine grassland-yak systems (Figure 3), desert grassland-goats-camel systems (Figure 4), and various intensive field crop-sheep systems. Visitors can also experience the unique cultures in the area including Tibetan, Yuku, Czech, Muslim and Mongolian. In addition, there are also many well-known historical sites located along the ancient Silk Road, some of them we will visit including Wuwei Leitai Tomb, Zhangye Grand Buddha Temple, Zhangye Danxia Landform (Figure 5) and Mogao Caves.

Figure 4. Desert grassland-camel system

Figure 5. Zhangye Danxia landform

Annual rain fall in Hexi corridor ranges from 100 to 150 mm with strong sunshine, which makes the region the largest seed production area in China. It is estimated that nearly 60% of field crops, including lucerne grown for seed, sown in China are produced in the Hexi Corridor. There are around 150 companies who conduct business on seeds for forage crops, corn and vegetables.

I look forward to meeting you at the 8th International Herbage Seed Conference in Lanzhou, China.

Managing Herbicide Resistance in Seed Production Cropping Systems: Finding Solutions for Growers

Andy Hulting, Oregon State University Extension Weed Management Specialist

The Research Process in Oregon

The OSU Weed Science Program conducts many different types of weed management studies across the seed growing regions of Oregon including herbicide evaluations to identify new chemical control strategies for difficult to manage weeds in seed crops, particularly grass seed. The process for US EPA registration of new herbicide products requires site-specific information on weed control efficacy, crop tolerance, and environmental behavior across a broad range of agricultural environments. We work with the agricultural chemical industry and the Oregon Department of Agriculture to help register safe, effective herbicide products. Our weed management research in grass seed production is also very reliant on OSU Extension county-based faculty, industry field consultants and seed growers. Industry field consultants and OSU faculty identify potential research sites and assist in site preparation for research, and growers often conduct common agronomic practices (fertility, insect and disease management, etc.) for these field based research studies. The new information derived from this research is circulated to Oregon seed growers and consultants using an array of programming methods including, grower and industry meetings, development of OSU Extension publications and, and the continued development of the seed production-focused chapters in the *Pacific Northwest Weed Management Handbook*.

Figure 1. Andy Hulting presenting herbicide plots to industry field reps at Hyslop Research Farm

Updates on Ongoing Research

Grass grown for seed has been the principle field crop in western Oregon in terms of value and acreage. The decrease in open field burning and shifting tillage practices to include more

conservation tillage and direct seeding have in some cases increased weed management problems on much of this acreage. Besides direct crop yield losses due to weed competition, weed seed contamination increases the cost of seed cleaning as well as affects certification of the seed and therefore the subsequent value of the crop. Herbicide and labor inputs for weed management add substantially to the cost of grass seed production, making continued development of viable weed management strategies imperative. Weed management in grass seed production is the largest research component of the OSU Weed Science Program. Developing management solutions for seed growers for problem weed species is the result of a long term commitment to evaluating, implementing, and refining herbicide applications and other control practices.

A large portion of our weed management research in grass seed focuses on grass weed species management. Research is also conducted to improve understanding of herbicide resistance in various weed species, and to identify management practices that prevent or delay the occurrence of herbicide-resistant weeds. While we have made significant progress in recent years, multiple-resistant populations of annual bluegrass (*Poa annua*) and roughstalk bluegrass (*Poa trivialis*) still reduce crop yield and quality in many production areas, and other grass weeds such as brome (*Bromus*) species and rattail fescue (*Vulpia myuros*), and broadleaf weeds, such as wild carrot (*Daucus carota*), are continual problems.

We have put a great deal of resources into projects that are designed to find alternatives to diuron use in the carbon-seeding grass establishment systems in western Oregon. Through the continued use of diuron followed by ethofumesate we have selected for annual and roughstalk bluegrass populations that are resistant to one or both of these herbicides. Over the last several years, we have identified herbicides that will provide control of these populations and that are good candidates for registration in grasses grown for seed. These herbicides, indaziflam, pyroxasulfone + flumioxazin and rimsulfuron, have been evaluated for grass crop tolerance and efficacy for the control of diuron-resistant annual and roughstalk bluegrass in carbon-seeded perennial ryegrass over the last several growing seasons. These herbicides are important from a resistance management perspective because they represent herbicide classes of chemistry or modes of action that are not utilized for weed management during the grass establishment year. The use of indaziflam in grass grown for seed would represent a truly unique class of herbicide chemistry that has yet to be utilized in grass seed cropping systems. In addition, we have also documented that fall-applied, preemergence applications of both indaziflam and pyroxasulfone + flumioxazin can provide excellent diuron resistant annual bluegrass control and volunteer grass control in established perennial ryegrass and tall fescue. But their use is not without the risk of crop injury. We are still busy refining the appropriate application rates of these two products

along with identifying tank mix partners to limit the potential for crop injury following their use in established grass.

By working in cooperation with industry partners we have been able to develop and demonstrate some new herbicide use patterns for grass seed producers that have been rapidly adopted to manage herbicide resistant weeds. For example, developing registrations for mesotrione and bromoxynil + pyrasulfotole for use in a variety of grass seed crops has given growers two non-volatile herbicide tools to manage broadleaf weeds when applied at appropriate timings as well preemergence (mesotrione) and postemergence (both mesotrione and bromoxynil + pyrasulfotole) tools to selectively control ethofumesate resistant mannagrass (*Glyceria*) species in annual ryegrass seed production. We have also recently worked to expand the use of glufosinate to allow for both fall and spring postemergence timings to manage resistant annual and roughstalk bluegrass biotypes in newly established and established grasses grown for seed. In addition, the broadleaf herbicide saflufenacil has been identified as a non-volatile herbicide that will provide growers with a new tool to manage broadleaf weeds (including biotypes resistant to glyphosate) in seedling and established grass seed crops.

In summary, managing herbicide resistance in seed production cropping systems is an ongoing task. But through research and education we can find creative solutions for seed growers to the problems they face. As a seed industry we need to be proactive in our education and research activities to stay ahead of management problems associated with herbicide resistance. Herbicide resistance in seed production systems is a complex issue and one that this industry will need to navigate successfully to keep demand for seed high.

A relatively minor portion of the seed research discussed in this article is supported by the agrichemical industry and is only provided to work on very specific projects. Therefore, I acknowledge and thank the Oregon Seed Council and other seed grower organizations for their continued funding of OSU research infrastructure and Extension programs over the years. We continue to build on this funding to pursue projects that are important for Oregon seed growers.
For more information on these projects or to provide feedback please contact me at andrew.hulting@oregonstate.edu

Improving seed yield in tetraploid red clover (*Trifolium pratense* L.)

Helga Amdahl, PhD student, Graminor Breeding Ltd. and Norwegian University of Life Sciences

Cultivated forage is grown on 57% of the cultivated agricultural area in Norway. Red clover (*Trifolium pratense* L.) is the most important forage legume in Norway, mostly grown in mixtures with other grasses. Red clover contributes to the quality of forage by increasing its protein amount and by increase of forage intake in ruminants and thus also production of milk and meat. In addition, red clover is fixing atmospheric nitrogen through symbiosis with soil bacteria (*Rhizobium trifolii*) and thus contributes to lower demand of nitrogen fertilization.

Tetraploid red clover is commonly obtained by doubling the chromosome number in naturally occurring diploid red clover. Tetraploid plants are larger, taller, have wider leaves, larger flower heads and longer stems that result in higher green mass and dry matter yield. Experiments show also that tetraploid varieties have better persistence and better winter hardiness than diploid varieties.

Tetraploid red clover has up to 20% higher forage yield compared to the diploid varieties. However, the main challenge of tetraploid red clover varieties is that it produces up to 40% lower amount of seed than diploid varieties. Due to this, Norwegian seed companies are reluctant to grow tetraploid red clover for seed.

Norwegian plant breeding company, Graminor Breeding Ltd., has initiated a project with an aim to improve the seed yield potential in tetraploid red clover. The first part of the project focuses on identification and description of different seed yield components (Easy-to-Score) in diverse tetraploid red clover material. In this part of the project field and single plant trials were established to analyze the most important Swedish and Norwegian commercial and upcoming varieties.

Picture 1: Single plant trial.

Picture 2: Registration of number of flower heads per m^2 in the seed yield field trial.

Correlation analysis has shown one Easy-to-Score seed yield component that can be implemented in the Norwegian forage breeding program for selection of improved seed yield cultivars.

Picture 3: Variability in the number of seed per flower head.

Picture 4: Single plant trial at maximum flowering.

Combined with this approach the project is aiming to develop molecular markers that can be used as a high throughput tool which will allow accurate identification of high seed yielding tetraploid red clover varieties. Since the improvement of traits by phenotypic selection is time consuming and laborious, development of molecular markers, which could assist conventional breeding techniques, would make it possible for breeders to select superior genotypes more efficiently by applying marker assisted selection. Based on analysis of results from RNA sequencing, several potential regulatory genes have been identified to play role in determining the seed yield. However, more analysis are still required to confirm these genes role in regulating seed setting in tetraploid red clover.

This research project is financed by Graminor Breeding Ltd. and the Norwegian Research Council under project number, 209702. The project is led by Dr. Muath Alsheikh, Graminor Breeding Ltd. and Norwegian University of Life Sciences. Helga Amdahl PhD thesis research is conducted under the supervision of Prof. Odd-Arne Rognli (Norwegian University of Life Sciences), Dr. Petter Marum (Graminor Breeding Ltd.) and Dr. Trygve S. Aamlid (Norwegian Institute for Agricultural and Environmental Research), and Dr. Muath Alsheikh.

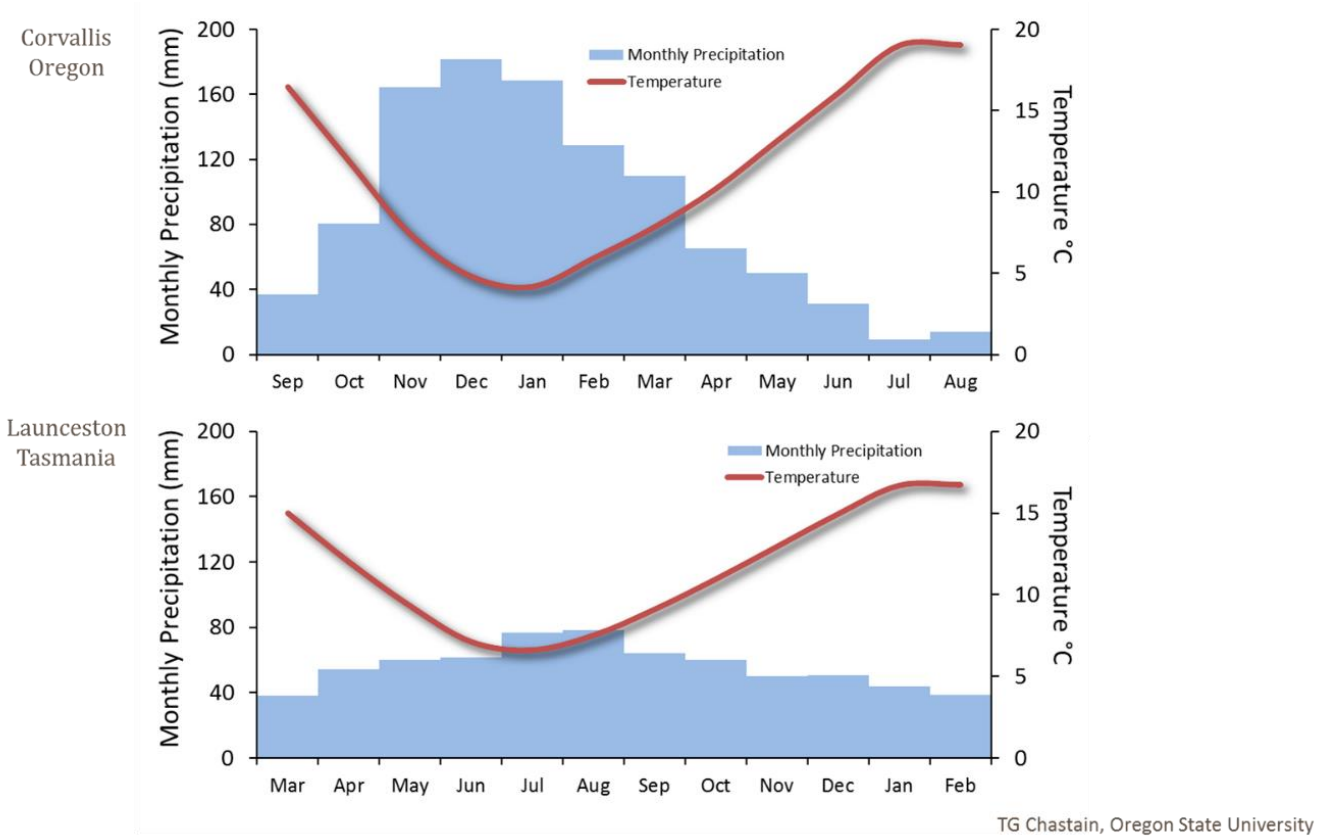
Tasmanian Pasture Seed Production Conference (Launceston, Tasmania, Australia)[1]

12-14 November 2014

Tasmania is an island that lies 240 km south of Australia between latitudes 41 and 42°S. The island is the 26th largest in the world and one-third of the islands 68,000 km^2 area is in agriculture. Major crops are wheat and barley, field peas and poppies (*Papaver somniferum*) sown on more than 20,000 hectares of land. Poppies provides 40% of the US market's legal opiate supply in the form of codeine, thebaine (also known as paramorphine) and other variants. There has been a small herbage seed industry for many years and the production base is often associated with a larger cropping and mixed sheep-cropping enterprises.

The conference was hosted by the Tasmanian Institute of Agriculture, the University of Tasmania, private seed companies and agricultural suppliers and banking interests and attended by 100 people and included presentations by several IHSG members; Tom Chastain (Oregon State University), Richard Chynoweth (FAR-NZ) and Murray Kelly (PGW Seeds, NZ). With good water resources and good volcanic derived soils there is potential for developing the seed industry, especially with crops maturing and being harvested for seed earlier than in New Zealand makes supplying the big autumn sown Australia market an opportunity. Tom and Richard noted they have a good climate for seed production with Launceston averaging 955 mm of rain fall, The climate for seed production is drier than Oregon's Willamette Valley and warmer than New Zealand's Canterbury Plains. Precipitation is relatively evenly distributed throughout the year compared to Oregon's Willamette Valley (see graph).

[1] From notes and comments from IHSG members Tom Chastain, Richard Chynoweth and Murray Kelly.



Current herbage seed production in Tasmania is estimated to be 3500 hectares. The production of proprietary cultivars of annual and Italian ryegrass is larger than perennial ryegrass. Some growers are achieving perennial ryegrass and annual ryegrass seed yields of 2,500 kg/ha with good seed quality. However other crops visited had issues with off-types, weeds, annual ryegrass contamination in turf ryegrass and tall fescue seed crops. Growers with poppies and sheep often were not giving the attention to detail that good quality herbage seed needs. There is currently a lack of cohesion between industry players and a lack of research supporting seed production. These are two critical elements needed to develop herbage seed. Turning potential into a vibrant industry is a challenge for Tasmania and for many other areas in the world.

Uruguay Seed Courses

In late July Lincoln University Seed Research Centre staff Prof John Hampton, Dr Phil Rolston and Ms Maria Elena Duter ran a highly successful one week Seed Technology Short course (28 participants from four countries) and one day Endophyte Workshop (16 participants from two countries) in Uruguay.

The Short Course had a seed quality focus and included "hands on" in seed testing methods, principles of seed processing, drying and storage, seed quality assurance, and production factors affecting seed quality. The participants who came from Uruguay, Argentina, Peru and Columbia, included private seed laboratory staff, seed company agronomists and researchers from INIA Uruguay. At the Endophyte Workshop participants learned about methods for detecting *Epichloe* endophytes and seed production factors affecting the success of vertical transmission.

This was the first off-shore venture with training from the Lincoln University Seed Research Centre, and from the positive feed-back received from the participants, is one likely to be repeated in South America in the future. Thanks to the staff of INASE (the Uruguay National Seed Institute) for the use of their facilities and the provision of technical assistance, to sponsors Duncan Ag and the Instituto Nacional de Investigación Agropecuaria (INIA), and to Maria Elena for her organisational skills and dedication to the event, literally losing her voice translating from English into Spanish!

Korea Rye Seed Production Workshop

YanRong Wang, College of Pastoral Agriculture Science and Technology, Lanzhou University, China

Korea produces a lot of rye (*Secale cereale*) crops which are mainly used as forage for cows and as manure. In October 2014, I had the opportunity to participate in a rye seed production workshop that was organized by Foundation of Agricultural Technology Commercialization & Transfer (FACT) and held in Suwon, Korea. I was invited to give a presentation entitled of "Forage crops cultivation and seed production in China", which included an overview of rye seed production in China. The workshop is part of activity in an annual review meeting of a national project named "Selection of optical production site and method for improving self-sufficiency of rye seed". There were about 15 attendees from Korea in the workshop, most of who work with the national project. This is a 3 year project lead by Dr Joung Kyong Lee, funded by Korean government. The project aimed to work towards achieving 50% self- sufficiency of total rye seed use in Korea. Rye cultivar 'Gogu', an early maturity and good yield variety developed in Korea, is the primary variety used in the project. This cultivar commonly achieves a seed yield of 3 ton/ha.

In Korea, rye is usually planted in fields following other crops such as rice, corn or sorgum. It is harvested in autumn or double cropped with corn in early spring. There are about 50,000 ha of rye planted for forage and manure crop each year. About 8,000 tons of rye seed are needed for this domestic production. Currently, most of the seed is imported from other countries.

Rye seed production workshop in Korea, 2014

Rye seed field prior to harvest

New Zealand FAR Crops Expo 2014

The annual Foundation for Arable Research (FAR) crop and herbage seed production field day is held on the first Wednesday each year in December at Chertsey (60 km south of Christchurch) and this year attracted over 500 visitors including from Australian, Argentina, Brazil and at least one Oregon farmer. The topics covered are largely around field trials at Chertsey and included a large sponsors section with demonstration plots of new products. If you are coming to New Zealand to view seed production then linking the timing of a visit to the FAR day will add value to your visit.

2014 FAR Crops Expo

Of relevance to herbage seed production:

- Ryegrass- impacts of sowing dates and sowing rates on seed production in irrigated and dryland adjacent sites. In this work Richard Chynoweth is trying to create crops that produce on primary tillers with a range of target populations at sowing from 200 to 1400 plants/m^2.
- Irrigation management of white clover and browntop. Richard Chynoweth has trials with five irrigation rate applications with a focus on flowering-seed fill period. Water is applied using a trickle tape delivery system allowing plots to be smaller but able to be machine harvested with a plot combine.
- Role of break crops in cropping rotations; especially the impact of brassica species in enhancing yields of cereals and other gramminae crops. The presentation was led by John Kirkegard of CSIRO Australia.
- Application technologies for reducing spray drift.
- Facing up to herbicide resistance in the arable industry.

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