# Keynote Address

# Ensuring the long term viability of the New Zealand seed industry

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## Abstract

New Zealand's seed industry occupies around 50,000 ha and produced around 130,000 tonnes seed in both 2010 and 2011. Most of this production is based in Canterbury. Ryegrasses and peas (at around 30,000 tonnes each) are the largest seed crops by volume, but cereals, forage brassicas, oilseeds, forage legumes and vegetable seeds are also important. The upstream impacts of the seed industry in 2011 were estimated at $228M in direct sales, a total impact of $610M, and a contribution to New Zealand's GDP of $271M. Downstream impacts for New Zealand's pasture improvement delivered via New Zealand produced seeds are estimated to contribute $3.2B to GDP annually. The seed industry is vitally important to New Zealand's land-based industries and currently vibrant, but there are various threats to its long term viability. These include competition for land use, high production costs, reducing options for the use of chemicals and fertilisers, climate change, and loss of industry knowledge and infrastructure. The loss of the seed industry would remove around $1.0B from the "seeds" contribution (direct and indirect) to the New Zealand economy, threaten the profitability/viability of New Zealand's pastoral production industries, remove the present grass endophyte capability, and stop the $150M annual seed export industry as well as other downstream impacts. A bright and productive future for the seed industry will therefore require increased profitability using sustainable production practices, seed quality improvement, strategies to mitigate the effects of a number of environmental changes and an expansion of seed industry knowledge. Overcoming present technical constraints will require both fundamental and applied research. The New Zealand Seed Alliance has been established to provide a mechanism for increasing investment in seed research and development, to provide increasing opportunities for the industry to meet present and future market demands, and to enhance co-operation among the public and private sectors of the New Zealand seed industry.

***Additional keywords:*** seed production, seed quality, seed certification, seed exports, economic impact, strategic importance, industry survival, seed research

## Introduction

New Zealand's early European farmers recognised the country's potential for seed production which was developed initially by multiplying seed lots of cereal, pasture and vegetable species imported primarily from the UK. Prior to the 1914-18 war, an active domestic and seed export market was well established. In 1917 the New Zealand Grain, Seed and Produce Merchants Federation was formed (Melhuish, 2008) and companies such as F. Cooper Ltd and Wright Stephenson & Co. were producing and exporting pea, vegetable, pasture and flower seeds (McKay, 2008). Forage and arable seeds were grown in both the North (Hawkes Bay, Wairarapa, Manawatu) and South (Marlborough, Canterbury, Otago, Southland) Islands, while vegetable seed production was centred on North Otago, Marlborough and Wairarapa. For reviews of the development of New Zealand seed industry see Hampton and Scott (1990), Rowarth *et al*. (1998), Melhuish (2008) and McKay (2008).

Today New Zealand's arable industry occupies around 150,000 ha, of which around 50,000 ha are used for seed production each year. This production is based on the temperate plains of the east coasts of both Islands, with the majority (approximately 90%) being grown in Canterbury. The main features of these seed production areas include fertile soils, the availability of irrigation, established and effective crop rotations, and a favourable climate (low humidity, warm days and cold nights). These combined with specialist seed growers, industry expertise and infrastructure, quality management systems, and seed research expertise in both the private and public sectors place New Zealand in a premium position in the global seed market, including the world leader in the production of white clover, carrot and radish seed.

## Present Seed Production

New Zealand's total seed production in 2010 was around 122,000 tonnes and in 2011 it was around 136,000 tonnes (Table 1). Grasses and pulses were produced in the greatest volumes, with ryegrasses and peas predominating at around 30,000 tonnes each. Forage legumes were dominated by white clover, forage brassicas by rape, cereals by wheat and barley, vegetables by radish, and oilseeds by canola (Table 1). In 2011, 27,803 ha was entered for seed certification (Table 2), with 60% of this area in grasses, (84% of which was ryegrasses), 26% in forage legumes (90% white clover), and the remainder including cereals, forage brassicas and miscellaneous other species. As a percentage of total production in 2011, certified seed accounted for 86% of cereals, 74% of forage legumes, 67% of grasses, 7% of forage brassicas and 1% of pulses (Sanderson *et al*., 2012). New Zealand's vegetable seed industry does not participate in the New Zealand seed certification scheme.

**Table 1:** New Zealand seed production, 2010 and 2011(tonnes ex farm)[1].

| Species | 2010 | 2011 | Species | 2010 | 2011 |
|---|---|---|---|---|---|
| Grasses | | | Forage Brassicas | | |
| ryegrass | 29,734 | 31,528 | rape | 3,506 | 6,642 |
| fescue | 214 | 542 | kale | 796 | 809 |
| cocksfoot | 273 | 440 | turnip | 192 | 339 |
| other grasses | 993 | 934 | swede | 75 | 31 |
| Total grasses | 31,214 | 33,444 | Total forage brassicas | 4,569 | 7,821 |
| | | | | | |
| Cereals[2] | | | Vegetables | | |
| wheat | 5,900 | 6,500 | brassicas | 873 | 1,116 |
| barley | 5,500 | 4,800 | radish | 2,532 | 2,012 |
| oats | 1,726 | 1,600 | carrot | 431 | 333 |
| ryecorn | 40 | 55 | beets | 70 | 107 |
| triticale | 900 | 875 | Total vegetables | 3,906 | 3,568 |
| maize | 210 | 200 | | | |
| other cereals | 455 | 500 | Oilseeds | | |
| Total cereals | 14,231 | 14,530 | linseed | 1,038 | 2,862 |
| | | | canola | 4,326 | 5,613 |
| | | | Total oilseeds | 5,364 | 8,475 |
| | | | | | |
| Forage legumes | | | Pulses | | |
| white clover | 3,108 | 3,745 | peas | 27,339 | 30,995 |
| red clover | 78 | 189 | beans | 3,873 | 4,215 |
| other forage legumes | 471 | 271 | other pulses | 12,781 | 28,457 |
| Total forage legumes | 3,657 | 4,205 | Total pulses | 43,993 | 63,667 |
| | | | | | |
| Miscellaneous | 1,070 | 842 | | | |
| Total New Zealand seed production | | | 2011 = 136,552 tonnes | | |
| | | | 2010 = 122,534 tonnes | | |

[1]Foundation for Arable Research commodity levy data, 2010 and 2011 (with the exception of cereals).
[2]Industry estimate of cereals provided by Ian Ormandy, PGG Wrightson Grain.

**Table 2:** Area entered for certified seed production in 2011 (hectares)[1].

| Species | Hectares | Species | Hectares |
|---|---|---|---|
| Grasses | | Cereals | |
| perennial ryegrass | 7,568 | wheat | 648 |
| Italian ryegrass | 5,140 | barley | 995 |
| hybrid ryegrass | 1,220 | oats | 445 |
| cocksfoot | 1,024 | ryecorn | 19 |
| tall fescue | 518 | triticale | 67 |
| brown top | 559 | maize | 293 |
| other grasses | 468 | Total cereals | 2,467 |
| Total grasses | 16,497 | | |
| | | Forage brassicas | |
| Forage legumes | | rape | 483 |
| white clover | 6,637 | kale | 501 |
| red clover | 554 | turnip | 201 |
| other forage legumes | 134 | swede | 26 |
| Total forage legumes | 7,325 | Total forage brassicas | 1,211 |
| Other species[2] | 303 | | |
| Total All Species 27,803 ha | | | |

[1]data from AsureQuality.

[2]includes linseed, chicory, fodder radish, plantain, white mustard, pea.

## Value of Seeds Produced

Sanderson *et al.* (2012) assessed the value of New Zealand produced seeds sold in 2011 at $220M, made up from grasses ($93.04M), forage legumes ($24.15M), forage brassicas ($13.4M), pulses ($52.87M) and vegetables ($35.36M). This total did not include cereals (because the data collected do not differentiate between cereal seed and grain). Cereal seed sales in 2011 are estimated at $7.1M, giving a total for the country of $227.8M. Around 60% of these sales by value were of uncertified seed and 40% of certified seed (Sanderson *et al*., 2012), primarily because of the contribution from uncertified pulse and vegetable seeds. For species in the seed certification scheme such as the forage grasses and legumes, around 75% of the sales were of certified seed. Price differentials for certified seed were between 22-35% higher than for uncertified seed of the same species. There was a large difference in the farm gate value of seeds/kg. For example, peas at around $1.00/kg, perennial ryegrass at $2.80/kg, forage rape at $4.40/kg, white clover at $6.00/kg, radish at $9.00/kg and hybrid carrot at $42.00/kg (Sanderson *et al*., 2012). Thus the total sales of $84.5M for ryegrasses were achieved by selling some 32,500 tonnes seed, while the total sales of $14.23M for carrot were achieved by selling 426 tonnes seed.

New Zealand companies export seed to the value of $130-$180M per year (MPI, 2012). Seed export values for 2010 and 2011 are provided in Table 3, but the data do not include pea and cereal seed exports. In 2010 grasses (33%) and vegetables (41%) contributed the majority of the $136.9M total, as they also did in 2011

(44% and 40% respectively of the $135.1M total). The forage species are exported all over the world, but primarily to Australia, South America and the EU (Rowarth *et al*., 1998; Pyke *et al*., 2004). With the exception of hybrid carrot seed, some of which is multiplied for a major European seed house, most vegetable seeds are exported to countries within the Asia-Pacific region (McKay, 2008).

**Table 3:** Major seed exports ($M) in 2010 and 2011[1].

| 2010 | | 2011 | |
|---|---|---|---|
| Species | FOB ($NZ) | Species | FOB ($NZ) |
| Grasses | | Grasses | |
| ryegrasses | 38.96M | ryegrasses | 50.22M |
| tall fescue | 3.41M | tall fescue | 1.98M |
| crested dogstail | 0.27M | crested dogstail | 0.20M |
| browntop | 1.53M | browntop | 1.76M |
| cocksfoot | 1.54M | cocksfoot | 1.55M |
| prairie grass | 0.57M | prairie grass | 0.54M |
| Total grasses | $46.28M | Total grasses | $56.25M |
| | | | |
| Forage legumes | | Forage legumes | |
| white clover | 16.14M | white clover | 14.15M |
| | | | |
| Forage brassicas | | Forage brassicas | |
| rape[2] | 7.60M | rape | 4.94M |
| kale | 4.59M | kale | 3.02M |
| turnip | 0.97M | turnip | 1.31M |
| swede | 0.01M | swede | 0.17M |
| Total brassicas | $13.17M | Total brassicas | $9.44M |
| | | | |
| Vegetables | | Vegetables | |
| radish | 23.80M | radish | 18.23M |
| carrot | 8.46M | carrot | 14.24M |
| cabbage | 4.72M | cabbage | 4.47M |
| mustard | 1.92M | mustard | 1.24M |
| onion | 0.37M | onion | 2.61M |
| beetroot | 0.46M | beetroot | 0.65M |
| silverbeet | 0.13M | silverbeet | - |
| vegetables unspecified | 21.43M | vegetables unspecified | 13.51M |
| Total vegetables | $61.29M | Total vegetables | $54.95M |
| | | | |
| Flowers | $0.74M | Flowers | $0.37M |
| | | | |
| Total all seeds[3] | $136.88M | Total all seeds[3] | $135.11M |

[1]Statistics New Zealand (2012).

[2]includes oilseed rape.

[3]data not available for pea and cereal seed exports.

## Economic Impact of the Seed Industry

Sanderson *et al*. (2012) estimated the economic impact of seed production in New Zealand by calculating data for gross output, the value added (or GDP) component and employment within the industry. Their analysis dealt only with the upstream impacts (through the supply of goods and services to seed growers, and household expenditure by those working directly and indirectly in seed production). They did not consider the economic impact of the downstream users of New Zealand grown seeds. Their analysis did not include cereal seeds. For 2011 they estimated that:

(1) For a total wholesale seed value of $220.7M, the indirect impact increased the gross output to $466.9M, and the total impact was $590.6M. Adding $7.1M of cereal seeds into the calculation increased gross output to $481.8M and total impact to $610.8M.
(2) The direct sale of $220M of seeds generated an added value of $77M, so that taking into account the total impacts, the seed industry made a contribution of $224M to GDP in the New Zealand economy. Adding cereal seeds into the calculations increased the added value to $87M and the GDP contribution to $271M.
(3) Direct employment within the seed industry was estimated to be 1,348 FTEs, and with total impacts this increased to 3,199 FTEs. Adding cereal seeds into the calculations increased the direct employment to 1,499 FTEs and the total to 3,559 FTEs.

An example of a downstream effect can be demonstrated for New Zealand pasture production, where genetic gains (improved production and quality) and bioprotection via seed transmitted fungal endophytes (leading to improved persistence; Hume *et al*., 2009) are delivered to New Zealand farmers through New Zealand produced pasture seeds. Brazendale *et al*. (2011) modelled the economic impact of dairy system pasture yield gains (up to 30%), increased pasture quality (up to 0.6 MJME/kg DM in energy content) and increased pasture persistence (from 4 to 8 years) on dairy farm profitability. Their model found that the upper limit for increased profitability was approximately $750/ha. If a mid-point was assumed to be $300/ha, this would equate to a total added value to New Zealand dairy farm profitability of $450M. Sanderson and Webster (2009) had early concluded that the total impact of seed delivered pasture improvement to New Zealand's GDP was $3.2B.

## Strategic Importance

The seed industry is important to New Zealand for a number of reasons including:

(1) Direct sales from seed are currently around $228M and the total impact is around $610M. From these sales the total contribution by the seed industry to New Zealand's GDP is around $271M, and employment within the industry is estimated at 3,559 FTEs.
(2) New Zealand's arable industry, which in 2011 had direct sales of $386M, a total impact of $1.03B and contributed $427M to New Zealand's GDP (Sanderson *et al*., 2012) relies primarily on New Zealand grown seed.
(3) New Zealand produced pasture seeds deliver the improved genetic and bioprotection required for improved pasture yield, quality and persistence for

New Zealand's $22B pastoral production industries, and are required to support the continued growth and development of these industries. They are crucial to underpinning New Zealand's "grassland farming" market advantage.

(4) Seed exports from New Zealand return around $150M annually.

(5) Seed crops play an important role in the crop rotations needed for sustainability of arable farming in New Zealand through improving soil quality (restorative grass crops), and fixing nitrogen (clovers, peas), and grass seed crops provide an important winter feed source for lamb finishing (>200,000 lambs/year) and dairy grazing.

(6) New Zealand's seed production latitude ($43^{o}$-$44^{o}$S) places it as the Southern Hemisphere place of first choice for producing seed for Northern Hemisphere companies in their winter; the only other options at a similar latitude are Tasmania (limited land availability) and Southern Chile (not suitable for seed production; McKay 2008). This global location makes New Zealand attractive for counter-season seed production (e.g. cereals) and multiplication and re-export for vegetable seeds and increasingly pasture seeds as well. For example, there is increasing interest from EU seed companies for counter season grass, clover and spring brassica seed multiplication.

(7) New Zealand's GM-free status is increasingly attractive for international companies wishing to ensure GM-free seed lots.

(8) Seed of New Zealand grass cultivars is the delivery mechanism for the biocontrol of pasture pests provided by grass endophytes.

(9) New Zealand's well deserved reputation for producing quality seeds at reasonable cost means that attitude changes by international farmers (particularly in the EU whereby seed production is increasingly being discarded in favour of arable (grain) crops) are increasing the attractiveness of New Zealand for production of the seed still required by those international farmers.

(10) For developing economies, New Zealand is being viewed as a reliable supplier of quality seed (multiplication for re-export) of crops needed to help improve food security.

If the New Zealand seed industry was lost entirely, or the ability to produce seeds was severely curtailed, the impacts on New Zealand and its primary industries would be substantial. For example:

(1) A potential loss of around $1.0B annually from the "seeds"' contribution (direct and indirect) to the New Zealand economy.

(2) A major threat to the profitability of New Zealand's pastoral production industries because of the loss of New Zealand bred pasture cultivars bred for New Zealand conditions.

(3) The potential loss of New Zealand's grass endophyte capability, currently valued at around $50M annually.

(4) The loss of the seed export business.

(5) A major problem for New Zealand's arable industry with the loss of cultivars bred/selected for New Zealand conditions and reductions in crop rotation options leading to increasing weed/pest/disease pressures,

and a significant impact on soil degradation because of a lack of a grass-based option in intensive arable rotations.

(6) Biosecurity issues would make it difficult to get the required species/cultivars/seed quantities into New Zealand placing the land-based industries at high risk for seed supply. There is also the risk of unwanted attributes being introduced (for example glyphosate resistant ryegrass which would add significantly to the cost of pasture renovation, therefore potentially reducing the frequency so that productivity would decrease).

(7) Loss of the present seed industry expertise and infrastructure which would make recovery of the industry at some future time extremely difficult and expensive.

## Situation Overview

The New Zealand seed industry is currently vibrant, so why be concerned about its long-term survival? Nearly a decade ago Pyke *et al*. (2004) in their commentary on herbage seed production noted that the future viability of the industry would require increased profitability for seed growers, and measures to combat issues around land use and water availability. In 2012 factors which are/could become threats to the industry's survival, let alone growth, include:

(1) Competition for land use. Dairy conversion is on the increase in Canterbury, and increasingly this is at the expense of irrigated arable farming. The problem is not one created by dairy farming alone - the issue is that with current seed yields and costs of production, it is becoming increasingly difficult for seed growers to compete with gross margins for other uses of the land.

(2) Production costs which mean that New Zealand seed production is no longer cost-competitive internationally, and therefore the seed export trade is lost or significantly reduced. For example, if (when?) water charges are introduced for irrigation, can the seed industry survive? Reducing water use may lower seed yields; maintaining current usage would increase production costs.

(3) Reducing options for the use of agricultural chemicals and bag nitrogen. Agriculture is approaching a crossroads in relation to the use of chemicals and bag nitrogen. Options for chemical control of weeds, pests and diseases are reducing because (i) there is minimal new chemistry, (ii) new products are being registered only for the world's five major crops (which do not include pastures or vegetables), (iii) resistance to chemicals by weeds, pests and pathogens is increasing, or (iv) older products are being withdrawn from approved use for environmental reasons or because no company will meet the costs of the testing required to allow re-registration. Regional councils are already introducing rules on nitrogen useage to reduce nitrogen leaching and loss to waterways. It is also entirely possible that a future New Zealand parliament will pass legislation that either directly restricts the amount of nitrogen that can be applied per hectare per year, or indirectly restricts by charges on energy, as a strategy to reduce greenhouse gas issues. Restriction on nitrogen use to reduce leaching losses has already occurred in one of New Zealand's seed production

competitors, Denmark (B. Boelt, pers. comm., 2012).

(4) Climate change. While Pyke *et al*. (1998) considered that projected climate change in Canterbury should increase the potential for seed production by providing a more predictable climate for production and harvest, Pyke *et al*. (2004) later tempered this by pointing out that any advantages may be threatened by the availability of irrigation water. While increasing atmospheric $CO_2$ levels may allow increased seed yields, this response is likely to be negated by the effects of increased temperature accelerating seed development and reducing seed germination and seed vigour (Hampton *et al*., 2012a). Increasing temperatures are also highly likely to reduce pollen viability and pollinator activity, thus reducing seed yields.

(5) Suitable seed production sites. Apart from competition for land use, other problems are arising on arable farms. These include finding the required isolation distances (e.g. 500 to 1500m for brassicas), contamination from the soil seed bank (e.g. volunteers of white clover, radish and brassicas), and an increasing problem with soil-borne plant pathogens (e.g. *Fusarium*, *Alternaria*, *Sclerotinia* and *Rhizoctonia*) because of curtailed rotations. As an example, the soil-borne inoculum of the carrot pathogen *Alternaria radicina* can survive in the absence of the carrot host for at least six years (Hampton *et al*., 2012b).

(6) Seed production knowledge. With climate change and other challenges it is possible that forage legumes and grasses other than white clover and ryegrasses (i.e. species that are presently "minor" in New Zealand or species new to New Zealand) may be in demand. Overseas customers may also require seed multiplication in New Zealand of new species (e.g. *Camelina* spp.) or cultivars of currently grown species with different attributes (e.g. late-flowering ryegrasses). Producing economically viable seed yields and high quality seed may require expertise not currently available in New Zealand.

(7) Endophyte. *Neotyphodium* endophytes are now an essential component of New Zealand perennial and hybrid ryegrass, festulolium and tall fescue seed production. However there are still problems with the success of endophyte transmission and survival in today's environment, and little knowledge of what effects climate change may have on grass endophytes. There is also a dearth of knowledge of vertically (seed) transmitted endophytes (both fungal and bacterial) in other plant species and whether they may have agriculturally desirable properties.

(8) Capability. Retirements from the Crown Research Institutes, Universities and seed companies over the next five to ten years will collectively remove 250 plus years of seed research expertise from the industry. There has been only a small number of new appointees over the past five years. Capability for the industry is diminishing.

## Industry Needs

A bright and productive future for the New Zealand seed industry will require:

(1) Increased profitability for seed growers, allowing them to better compete with other uses for the land. This will require the ability to produce higher yields and to manage/reduce the risks that cause large year-to-year seed yield fluctuations for many crops, all done using sustainable seed production practices and a strong cereal industry to support crop rotations and investments in machinery common to both industries.
(2) An increased emphasis on seed quality improvement.
(3) Having strategies to mitigate the effects of environmental changes including climate change effects, water availability and use, reduced chemical options, reduced fertiliser use, increased pest and disease pressures.
(4) An expansion of existing seed industry production knowledge, New Zealand seed research capability and plant breeding capability.
(5) Building a strong global position as a "first choice" producer of seed for international markets, thereby increasing seed exports.
(6) Delivering products beneficial for seed production with seed, for example biocontrol, growth promotion and germination delay.

There are currently a number of technical constraints to achieving these needs. They include poor pollination and seed set, the large gap between potential and actual seed yields in many species, limited understanding of water and nitrogen use efficiency, coping with abiotic stresses affecting both seed yield and quality, large harvest losses, increasing weed/pest/disease pressures with reducing options for chemical control but very few non-chemical alternatives, and maintaining seed quality post-harvest. Overcoming these constraints will require research, both fundamental and applied, by New Zealand's seed researchers.

## The New Zealand Seed Alliance

A strong New Zealand seed industry is critical to the continued economic prosperity of the country's land-based industries, and it is therefore important that seed research in New Zealand continues to be cohesive and working towards industry agreed goals. To this end "The New Zealand Seed Alliance" has recently been established for the purpose of:

(1) Increasing investment in New Zealand seed research and development.
(2) Increasing opportunities for the New Zealand seed industry to meet present and future market demands.
(3) Enhancing co-operation among the private and public sectors of the New Zealand seed industry.

The Alliance is among the seed research organisations (Lincoln University, AgResearch, Plant & Food Research, University of Canterbury), New Zealand seed companies and seed grower organisations, including the Foundation for Arable Research. It will provide a research critical mass which will be significant on a global scale, an increased portfolio range, and demonstrated partnerships between seed researchers, industry and end users. This mechanism will allow New Zealand's seed researchers and industry to collectively enhance New Zealand seed growers' ability to increase profitability by producing consistently high yields of the high quality seed required by domestic and international markets, to allow seed companies to earn

the revenue projected, and to build new opportunities for future industry sustainability.

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