Trends in New Zealand herbage seed production: 2004 -2014

R.J. Chynoweth[1], N.B. Pyke[1], M.P. Rolston[2] and M. Kelly[3]
[1]Foundation for Arable Research, P.O. Box 23133, Templeton 8445, New Zealand
[2]AgResearch Lincoln Research Centre, Private Bag 4749, Christchurch 8140, New Zealand
[3]Kimihia Research Centre, PGG Wrightson Seeds, Lincoln, New Zealand

Abstract

Three main species, perennial ryegrass, Italian ryegrass and white clover continue to dominate herbage seed production in New Zealand (NZ) and account for more than 85% of the annual herbage seed production area. Between 2004 and 2014 there was on average 18,000 ha of certified ryegrass seed production (range 12,900-19,000 ha) and 7,650 ha of white clover (range 6,100-10,800 ha). The ryegrass seed production area has been relatively stable since 2004 compared with white clover where the area of production decreased at approximately 175 ha/year from approximately 7,750 ha in 2004 to approximately 6,000 ha in 2014. Crops which have generally increased in area between 2004 and 2014 include Festulolium (941 ha) and plantain (392 ha). There is a downward trend in the total area of herbage seed production, largely as a result of decreasing white clover seed production. Other species have remained relatively constant overall with some year to year variation. There has been a continued shift to growing proprietary cultivars which in 2014 made up over 74% of the ryegrass area and approximately 70% of the white clover area compared with 30% in the late 1990's for both species. In perennial ryegrass there has been a shift to multiplying seed lines for companies based in the Northern Hemisphere, and these now make up more than 30% of the seed lines and area grown. Many of these cultivars bring genetics which are late flowering by NZ standards and this raises new production challenges for growers to overcome (e.g. increased disease pressure, increased water requirements and clashes around harvest timing). The downward trend in crop area has been offset by increases in seed yield per ha, largely driven by advances in crop husbandry. On average, seed yield has increased by 36 kg/ha/year for perennial ryegrass, 46 kg/ha/year for Italian ryegrass and 45 kg/ha/year for Hybrid ryegrass. In white clover, seed yield of proprietary cultivars has increased by 14 kg/ha/year compared with 5 kg/ha/year for Grasslands Huia. Information transfer through up skilling company representatives and seed producers on better management associated with grazing, nitrogen, plant growth regulators and irrigation has been key to increasing seed yields.

Additional keywords: Crop area, *Lolium* spp., ryegrass, seed yield, *Trifolium repens*, white clover

Introduction

Seed production in New Zealand (NZ) started in the mid-1850's on Banks Peninsula where cocksfoot (*Dactylis glomerata* L.) seed was produced until the 1930's (Wood, 2014). As harvesting

became mechanised the grass seed industry moved from Banks Peninsula onto the Canterbury plains and has steadily grown into a world leading industry. For the 2015 harvest ryegrass seed exports were worth $56 m and clover seeds $25 m; combined they make up 34.6% of the total arable export value (MPI, 2015). The largest export markets for ryegrass seed were Australia (25%), Chile (13%) and the Netherlands (12%). For white clover, the Netherlands (21%), United Kingdom (14%) and France (12%) were the largest markets.

Herbage seed production has historically been dominated by temperate grasses, predominantly perennial (*Lolium perenne* L.), Italian and annual ryegrass (*L. multiflorum* L.) and legumes, mainly white clover (*Trifolium repens* L.) (Pyke *et al.*, 2004; Rolston and Archie, 2005). However NZ seed production now includes many vegetable seed crops which have a similar export value as herbage seed crops (Hampton *et al.*, 2012; MPI, 2015).

Previous reviews of herbage seed production in NZ include those by Rolston and Clifford (1989) and Pyke *et al.* (2004). This paper reviews production area and seed yield data, predominantly post-2004, extracted from Seed Certification Statistics available from AsureQuality Limited. Where appropriate, data from a species are compared with the industry 'public' cultivars e.g. Grasslands Nui perennial ryegrass or Grasslands Huia white clover. Overall, average seed yields have increased over time but are still well below those achieved by top growers. Reasons for this are discussed.

Methods

Data on seed production area and total machine dressed seed weights were extracted from the Seed Certification Statistics available from AsureQuality Limited.

Data from 1986 through 2009 was extracted from Seed Certification Statistics published annually by MAF until 1998 (MAF, 1991; 1995; 1997), AgriQuality until 2007 (AgriQuality, 2000; 2001; 2003; 2004; 2007) and AsureQuality until 2009 (AsureQuality, 2008; 2009). Data post 2009 was extracted from the AsureQuality electronic data base (AsureQuality Limited, Lincoln, NZ).

Data were aligned for harvest year; for example, the area entered into certification in 2005 was aligned with the machine dressed weights from the 2006 harvest. Thus the year presented refers to the harvest year. No estimates are made for uncertified crops. Where production area and seed yield trends are discussed the data is presented as a moving average consisting of three seasons. The moving average reduces variability within the data provided by the 'public' cultivars e.g. Grasslands Nui and Huia which may not be machine dressed in the season they were planted, thus avoiding assigning the weight of seed produced to the incorrect harvest season. Presenting data as a moving average removes some of the seasonal production variability which limited the ability to compare seasons. All regression analysis was carried out in GenStat (16th Edition, VSN International Ltd, UK).

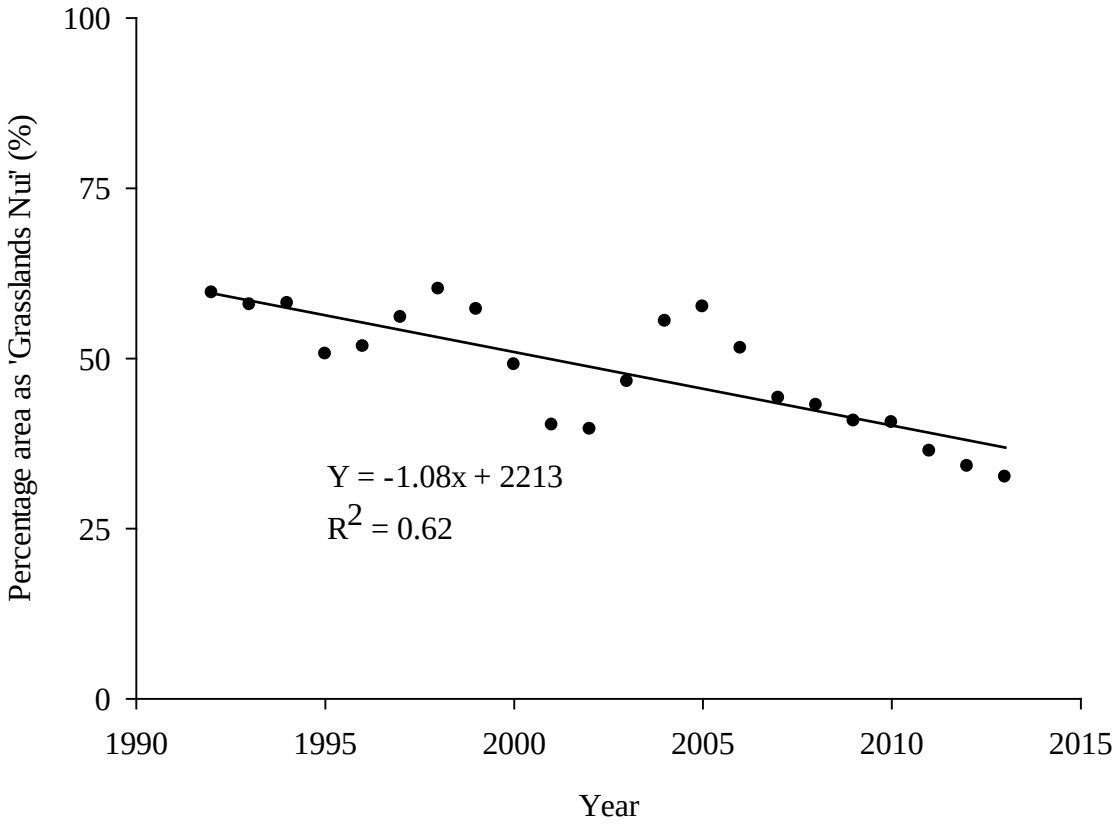

Figure 1: Changes in the percentage area of certified perennial ryegrass, cultivar Grasslands Nui grown for seed between 1992 and 2013. Percentages are expressed as the mean of three seasons (moving average). Year refers to harvest season of the middle year. Data is based on Seed Certification Statistics from AsureQuality Limited.

Results and Discussion

Ryegrass

Crop area and trends in 'public' cultivars

In the 10 years from 2004-2014 the area of certified ryegrass production averaged 18,000 ha. This is similar to that presented by Pyke *et al.* (2004) for the decade 1994-2003. Pyke *et al.* (2004) reported a shift away from 'public' to company proprietary cultivars. This trend has continued between 2004-2013 with 'Grassland Nui' making up approximately 32% of the perennial ryegrass area grown in 2013 compared with 60% in 1998 (expressed as the mean of three seasons) (Figure 1). Variation driven by economic decisions exists but the decline has averaged 1.1% of the perennial ryegrass area since 1995. The reduction in the volume of Grasslands Nui since 2005 reflects reduced demand in the North American turf industry due to the economic downturn, over supply from Oregon for the domestic USA market, and tougher standards around the level of *Poa annua* L. in turf seed lines. Other factors contributing to the decline in the percentage area grown as Grasslands Nui include the introduction of new European-based companies entering the NZ production area. These include Germinal Seeds Ltd (NZ Seed Houses Ltd), DLF Seeds, and others entering or

increasing production in partnership with seed companies present in NZ, e.g. the Royal Barenbrug Group through NZ Agriseeds Ltd, and RAGT Semences through Joordens Zaden BV and Seed Force Ltd. Many of these European cultivars are imported, grown in NZ and then re-exported with limited or no seed sales in NZ. With new cultivars comes production issues. Many of these cultivars have heading and flowering dates which are late to very late by NZ standards i.e. 20-30 days later than Grasslands Nui, and in many cases the actual heading date in NZ is unknown. Unknown developmental timings cause issues for growers around grazing management, plant growth regulator (PGR) and fungicide timings, and to a lesser extent nitrogen timings. Thus, management of late flowering ryegrasses has required increased research activity since 2006, with over 40 individual field trials investigating grower management techniques (31 funded by the Foundation for Arable Research, 14 funded by PGG Wrightson Limited).

In comparison for Grasslands Moata and Grasslands Tama the percentage of the Italian and annual production has not changed since 1992. Grasslands Moata and Grasslands Tama are predominantly used within NZ and thus they have not had large export volumes.

Seed yield

Seed yield of all ryegrass classifications has increased at a steady rate since 1992 (Figure 2). The three year mean seed yield in 2012 (mean of 2011, 2012 and 2013) for perennial (1,700 kg/ha), Italian (1,750 kg/ha) and Hybrid (1,730 kg/ha) type ryegrass reflects a seed yield increase at an average rate of 36, 46 and 45 kg/ha/year respectively over a 23 year span. This rate of seed yield increase has largely been through changes in agronomic practice as opposed to advancements in genetics. Evidence of this is seen in the slope of seed yield change for Grasslands Nui which is 33.5 kg/ha/year compared with 37 kg/ha/year for all other cultivars. This is not surprising as breeding for seed yield is often considered secondary to forage and turf quality or not considered at all (Stewart, 2015). Changes in agronomic practice that have increased seed yields include the introduction of new fungicides (Rolston *et al.*, 2009) and plant growth regulators (Chynoweth *et al.*, 2010; Rolston *et al.*, 2010b), better use of nitrogen fertilisers (Rolston *et al.*, 2010a), increased ability of growers to apply irrigation to remove water stress effects (Chynoweth *et al.*, 2012b) and understanding interactions between management inputs (Chynoweth *et al.*, 2010; Rolston *et al.*, 2007). Increased irrigation availability has led to increased reliability of production, particularly of Italian type ryegrass which showed large seed yield depressions in the late 1990's following two years of drought.

Agronomic gain highlights a successful extension method. The main mechanism for information transfer has been on farm discussion groups at key times through the growing season. These groups were started in 1993 (Rolston, 1995) and are still extremely popular in 2014 (Pyke *et al.*, 2015). These discussion groups are probably unique in that the facilitators represent four organisations; AgResearch Ltd (Crown Research Institute), FAR (grower levy research and development organisation), NZArable (an independent research company) and PGG Wrightson Seeds (a commercial seed company), and that the facilitators are some of the most experienced research and extension personnel in NZ. Uptake of new production

methods from the information presented at these discussion groups is rapid. Payne *et al.* (2009) reported 4.6 changes to on farm management were made by farmers attending these sort of meetings compared with two changes made by farmers not attending.

Ongoing investment in irrigation in NZ will help reduce seasonal variability. As a result, grass seed export volumes are expected to continue to follow the trend of the past decade and slowly increase. The severe drought that reduced the 2015 Oregon ryegrass harvest by approximately 25% should also help export volumes in 2015. However, this may not translate into an increase in production area if seed yield increases continue on a per hectare basis.

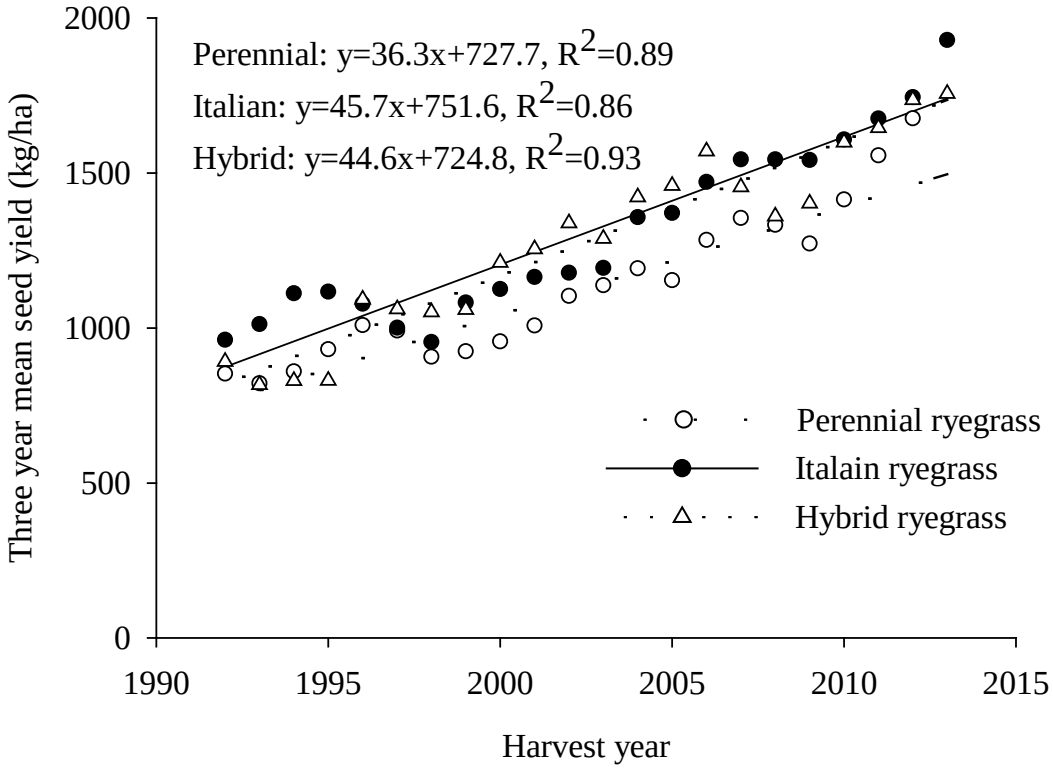

Figure 2: Three year mean seed yield (moving average) of three ryegrass species grown in New Zealand. Data based on Seed Certification Statistics from AsureQuality Limited. Year refers to harvest season of the middle year.

Endophyte

Fungal endophytes (*Epichloë* spp.) co-evolved with many grass species in a mutualistic co-existence with the endophyte producing a range of alkaloids that protect the plant against insect pests, herbivores and environmental stress. The selection of animal safe endophytes and incorporation into grass species including AR1, AR37, NEA2 and U2, AR542 and AR584 in tall fescue, and Avanex® in turf ryegrass has resulted in >90% of all NZ bred or marketed proprietary forage tall fescue, perennial and hybrid ryegrass cultivars containing at least one endophyte. This has led to additional challenges for herbage seed companies and growers to achieve seed products that not only meet the NZ Seed Certification purity standards and the industry accepted non-certification quality

requirements such as high germination, but concurrently deliver a high level of viable endophyte. This requires attention at every step of production, but especially in the use of fungicides for control of stem rust (*Puccinia graminis*) and blind seed disease (*Gloeotinia temulenta*) (Chynoweth *et al.*, 2012a). Increased knowledge has also been required in the handling of seed at harvest, post-harvest and during seed storage (Hume *et al.*, 2011).

White Clover

Crop area

The total area of certified white clover has continued to decrease since the mid-1990's. The percentage of crop grown made up of the 'public' cultivar, Grasslands Huia, has continued to fall to approximately 30% in 2013, down from 40% in 2003 and 70% in 1994 (Pyke *et al.*, 2004). The area of propriety cultivars has remained relatively constant, suggesting a number of growers have ceased growing Grasslands Huia. The decline in area of Grasslands Huia is partly due to the expansion of Hafia and Nanouk production in Australia, Denmark and the United States (Oregon). The Grasslands Huia, Hafia and Nanouk cultivars are traded as a commodity, are generally higher yielding (particularly Hafia and Nanouk) and often less persistent and cheaper for the end user. Thus they rely on their low cost to gain market share. In the future, potentially higher value interspecific hybrid clovers (Williams, 2014) are likely to add value and potentially area to clover seed production in NZ.

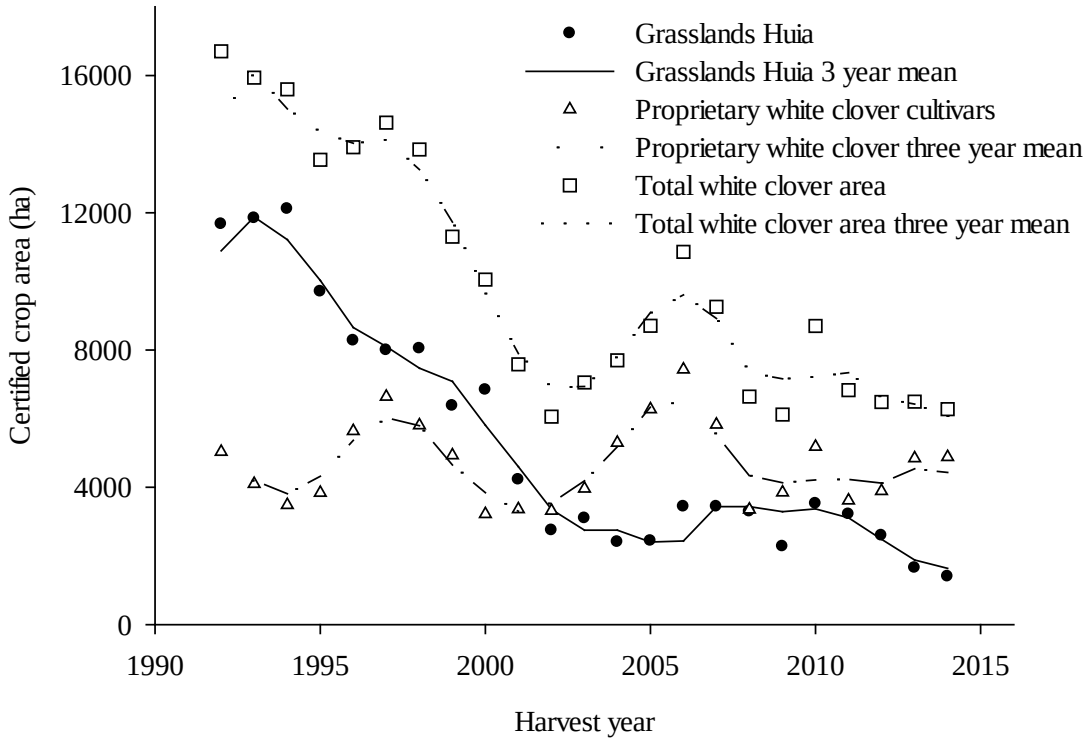

Figure 3: Total area of certified white clover seed production including the split between Grasslands Huia and other cultivars grown in New Zealand between 1992 and 2013. Solid and dotted lines represent the three year mean. Data based on Seed Certification Statistics from AsureQuality Limited.

Seed yield

Average white clover seed yields are still low at approximately 470 kg/ha, but similar to yields in Oregon (Chastain, 2015). Unlike perennial ryegrass, the yield difference between the common cultivar Grasslands Huia (increasing at 5kg/ha/year) and proprietary cultivars (14 kg/ha/year) is widening due to greater increase in seed yield in proprietary cultivars (Figure 4). Possible explanations include genetic advances in seed yield (Widdup *et al.*, 2004; Woodfield *et al.*, 2004) and/or that proprietary cultivars are grown by more experienced growers. Proprietary cultivars often return a higher income to the grower, thus encouraging extra inputs around weed and pest control and subsequently leading to a more reliable seed crop to the contracting company.

Number of cultivars and industry growth

Information prior to 1998 was presented by Rowarth *et al.* (1998) who identified an increase in the number of ryegrass and white clover cultivars. The number of ryegrass cultivars has continued to increase from the 75 in 1998 to greater than 185 individual cultivars in 2012 (Figure 5). For ryegrasses the increase in number of cultivars provides difficulties in production associated with maintaining genetic purity (currently controlled though seed certification), identifying and implementing the correct management practices and maintaining high levels of seed quality across the large variation in heading and flowering dates associated with diverse genetics. The number of white clover cultivars appears relatively stable at about 43.

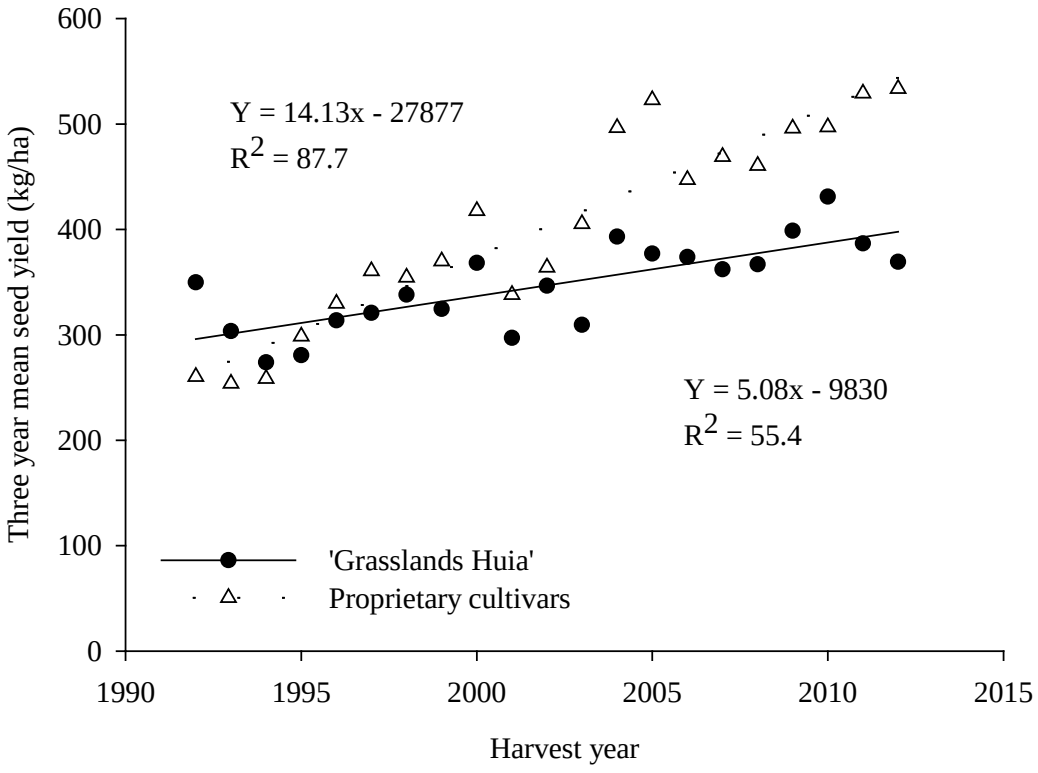

Figure 4: Three year mean seed yield of Grasslands Huia and all other white clover cultivars grown in New Zealand. Data based on Seed Certification Statistics from AsureQuality Limited. Year refers to harvest season of the middle season.

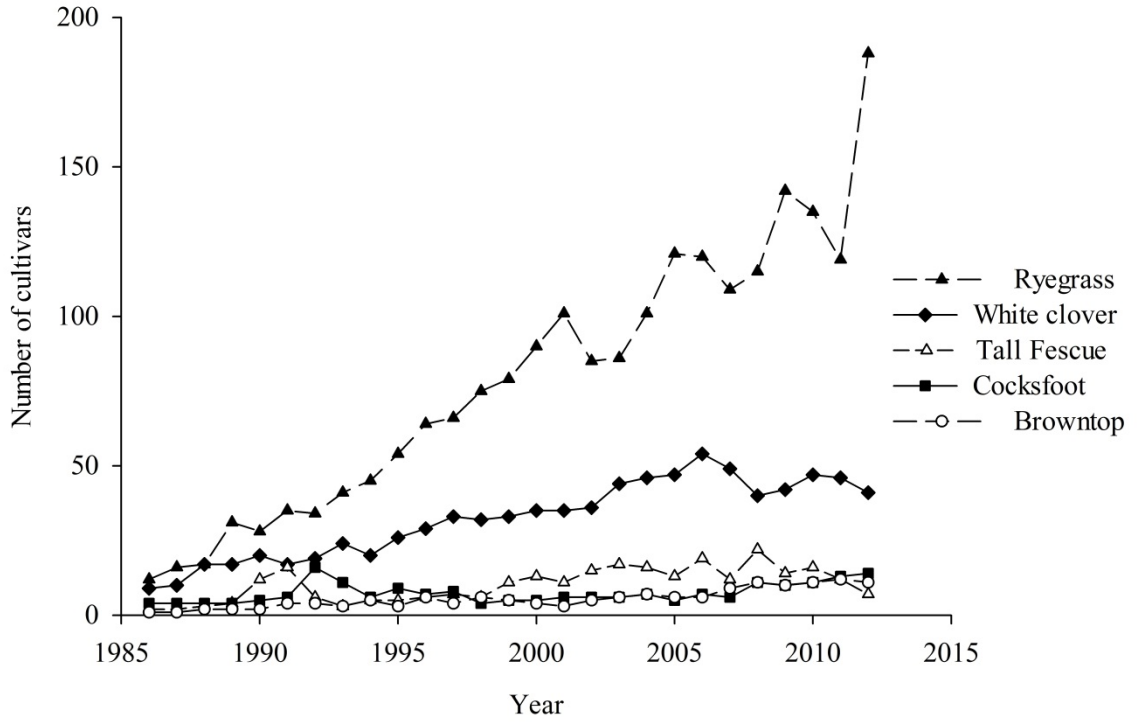

Figure 5: Number of cultivars of ryegrass, white clover, tall fescue (*Festuca arundinacea* Schreb.), cocksfoot (*Dactylis glomerata*) and browntop (*Agrostis tenuis* Sibth.) in the New Zealand Seed Certification Scheme between 1986 and 2012. Data based on Seed Certification Statistics from AssureQuality Limited.

Conclusions

The area of certified ryegrass seed crops has remained similar to that of the previous decade but that of white clover has declined. Seed yields of ryegrass and white clover have increased over this time. In ryegrass the seed yield increase has been largely due to better agronomic practices by growers as opposed to genetic gains. In white clover the reason for the seed yield increases is less clear. There continues to be a large increase in the number of ryegrass cultivars grown for seed, raising potential issues for growers around crop husbandry and maintaining genetic purity.

Acknowledgements

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