Laidig, F., Piepho, HP., Drobek, T. et al. Genetic and non-genetic long-term trends of 12 different crops in German official variety performance trials and on-farm yield trends. Theor Appl Genet 127, 2599–2617 (2014). <https://doi.org/10.1007/s00122-014-2402-z>

We analysed yield progress of 12 important field crops in Germany over the last 30 years, covering 85 % of arable land. The overall yield trend in variety trials was in the range of 0.15 % p.a. for perennial ryegrass total dry matter to 2.04 % p.a. for corrected sugar yield, based on 1983 yield levels. New varieties are the driving force of yield improvement. No decline of genetic progress was observed over time. We showed that for crops other than sugar beets there would have been only moderate increases in yield, for some crops even a decline, if no new varieties had been released. We found significant genetic trends for all crops (except for Italian ryegrass cut 1) covering a wide range of 0.16 % p.a. for dry matter yield of Italian ryegrass up to 1.86 % p.a. for oil yield, while the agronomic trend was between −0.75 % p.a. for forage maize fresh matter yield and 1.12 % p.a. for corrected sugar yield, and mostly not significant. Comparison of treated and untreated cereal trials revealed significant ageing effects. When interpreting genetic and agronomic trends estimated from historical data, we should be aware that rates may be biased if age effects are present. This study showed that progress in trial yield was transferred only partially to on-farm yield. For all crops even a widening of gap trends was observed. The highest rate of 0.76 % p.a. was found for winter rye. Relative gaps in 2012 are in the range of 23 % for winter wheat and 43 % for winter rye indicating a considerable potential for on-farm yield improvement. Various reasons may be responsible for the apparent gaps, depending on the crop. Shift in acreage, agricultural policy measures and economic reasons to reduce input seem to be of major influence. For the future new improved varieties must continue to be the driving force to generate yield progress. Advanced and locally adapted management technology is needed to translate genetic gain to higher farm yields in order to close yield gaps and to keep in pace with an increasing demand for food needed for a growing world population, and in Germany especially for covering a growing demand for biogas production and renewable resources.

<https://link.springer.com/article/10.1007/s00122-014-2402-z>

Perennial ryegrass cultivars: herbage yield in multi-site plot trials (H.S. Easton et al.) Proceedings of the New Zealand Grassland Association 63:183–188(2001)

Perennial ryegrass (Lolium perenne) cultivars adapted to New Zealand conditions are bred by several scientifically equipped New Zealand interests. New cultivars are evaluated in a network of trials organised by the New Zealand Plant Breeding and Research Association. This paper presents data from 17 trials completed throughout New Zealand since 1991. Data were analysed for each trial and then in a multi-site analysis enabling comparison of estimated cultivar means, over all New Zealand trials, North Island trials and Canterbury trials. New cultivars released to the market yielded on average 6% more herbage annually, and 9% in summer, than cultivars available before 1991. Other cultivars were evaluated but showed no yield advantage and have not been commercially released. Point analysis of plots in the final season of trials indicated that recently released cultivars maintain ground cover at least as well as the older ones. Limited data for rust infection indicated that the oldest cultivars are the most severely affected. Keywords: cultivar evaluation, endophyte, NZPBRA, pasture plant breeding, perennial ryegrass

<https://www.nzgajournal.org.nz/index.php/ProNZGA/article/view/2408/2036>

**tęsinys**

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Managing resilience of forage crops to climate change through response diversity,

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Abstract: Diversity appears to be critical in enhancing the resilience of agriculture in the face of climate change and the increasing intensity and frequency of extreme weather events. However, every kind of diversity does not necessarily enhance resilience, but the diversity among responses is critical. Such response diversity reflects the ability to perform well under various conditions and the capacity within a single function to adapt to various changes. Here, we propose a method for quantifying response diversity to aid the management of resilience. We hypothesized that there is practically significant diversity in yield responses to the critical agro-climatic factors within the set of forage crop species and cultivars. Using data from multi-location forage crop cultivar trials (from 1980 to 2012), we quantified the response diversity in high-latitude (60–66°N) conditions to agro-climatic factors critical for the yield of the following species: Timothy (Phleum pratense L.), meadow fescue (Festuca pratensis Huds.), tall fescue (Lolium arundinaceum (Schreb)), Festulolium (Festuca sp.×Lolium sp.), red clover (Trifolium pratense L.) and Italian ryegrass (Lolium multiflorum L.). The agro-climatic factors determined to be the most critical explained 77% of the total yield variation. Ten clusters of cultivars best reflected the high response diversity occurring within the species. The magnitude of variation among the cultivars in dry matter yield response to the agro-climatic factors was 12–17% of the mean yield of all the cultivars. However, not all species showed response diversity to all critical weather conditions. We conclude that complementary responses of species and cultivars can practically significant enhance the performance of forage production under conditions of weather variability. Management options are also discussed.

Keywords: Response diversity; Adaptive management; Forage crops; Yield; Resilience

Most of the Italian ryegrass cultivars were loaded in a cluster (Fig 1) where the warm growth period increased yields, but slightly less than for the other forages (Fig 2). Italian ryegrass is an annual crop under Finnish conditions and is thus sown each spring. There were three fescue-dominated clusters (Fig 1). The largest fescue cluster (1) was almost exclusively comprised of meadow fescue cultivars, but another fescue cluster (6) was a combination of various fescue types: meadow fescue, festulolium and tall fescue cultivars, together with a few Italian ryegrass cultivars.

<https://www.sciencedirect.com/science/article/pii/S0378429015300095>

The Italian ryegrass field trial lasted for 13 years, from 2009 to 2022 (year 2015 was missed). The mean total dry matter yield (DMY) ranged from 5586 kg ha-1 to 14781 kg ha-1, CV = 26.9 % (Figure 1). The 1st cut DMY highly varied between the years (CV = 59 %), constituted from 24 % to 72 % of total DMY and had a very strong positive correlation (r = 0.95) with it. The 2nd cut DMY was the least variable, CV was 19 %. It constituted from 49 % to 22 % of total DMY ( 35 % on average). The CV of 3rd cut was 50 % but it only contributed 16 % of total DMY on average. The 4th cut was harvested only in 4 years out of 13 and had the smallest DMY, which made up only 1 % to 15 % of total DMY. The last 3 years of experiment were also the most productive and had high 1st and 2nd cut DMYs, but low 3rd cut DMYs (Table 1).