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Traditional grasslands

Conservation measures needed?

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Policy Brief

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Abstract

A number of temperate grasses and legumes, important for animal feeding, have their centre of diversity in the North-West European region, including perennial ryegrass (*Lolium perenne* L.; Engels raaigras), white clover (*Trifolium repens* L.; witte klaver) and Kentucky bluegrass (*Poa pratensis* L.; veldbeemdgras). These species traditionally occur in Dutch grasslands where they can be considered as typical.
Undisturbed grasslands that are still in agricultural use have severely become reduced in number in the Netherlands. To investigate the need for conservation policies for such grasslands, diversity was assessed in perennial ryegrass, white clover and Kentucky bluegrass collected from traditional grasslands. This diversity was then compared with the diversity in commercial reference cultivars and in grasslands from nature reserves. Diversity estimation included morphological analyses and molecular characterization.
The analyses indicated no substantial distinction between the gene pools of the three investigated groups for any of the three investigated species. In particular, comparison of traditional grasslands with grasslands from nature reserves indicated that basically these two groups covered the same range of genetic variation. It was therefore concluded that no specific *in situ* conservation measures are currently needed to maintain the genetic diversity of perennial ryegrass, white clover and Kentucky bluegrass occurring in traditional grasslands, considering that nature reserves are already under protective measures.
Because perennial ryegrass, white clover and Kentucky bluegrass can be regarded key species of grasslands, the obtained results may be indicative of other species with similar life-history characteristics. Therefore, the need for specific conservation measures for traditional grasslands cannot be warranted.

1. Background

According to one of the objectives of the Convention on Biodiversity (CBD, 1992), member states have the responsibility to conserve the biodiversity under their jurisdiction. To this aim, the CBD recognizes *ex situ* and *in situ* strategies as complementary approaches. The Netherlands is situated in the North-West European part of the European-Siberian region of diversity, harboring only limited biodiversity of cultivated crops *in situ*. However, a number of temperate grasses and legumes, traditionally occurring in grasslands and important for animal feeding, have their centre of diversity in this region, including perennial ryegrass (*Lolium perenne* L.), white clover (*Trifolium repens* L.) and Kentucky bluegrass (*Poa pratensis* L.). Whereas perennial ryegrass and white clover are typical outcrossing species, Kentucky bluegrass reproduces mainly through apomixis (i.e. seed production without fertilization).

Optimization of fodder production during the last few decades may have strongly reduced the biodiversity within temperate grasslands. Original grassland vegetation has been replaced by more uniform cultivars, adapted to the application of high doses of nitrogen fertilizer. In cultivated grasslands clovers have largely disappeared because of high nitrogen inputs. In the Netherlands, grasslands which have not been resown over the last four decades and which received no, or only small amounts, of nitrogen have become greatly reduced in number. In 1998, an extensive farm survey by the Centre for Genetic Resources, the Netherlands (CGN) revealed the location of only fifty of such grasslands still in agricultural use; these were subsequently designated “traditional grasslands” (Figure 1). Since then, the number of traditional grasslands continued to decrease. Future survival of traditional grasslands and hence any unique genetic diversity contained in such systems can be considered unlikely.

Therefore, diversity in perennial ryegrass, white clover and Kentucky bluegrass sampled from traditional grasslands was assessed, and compared with the genetic diversity of cultivars that had a major share in the cultivation of Dutch grasslands. In addition, a comparison was made with the diversity of the species occurring in grasslands from Dutch nature reserves. Aim of the study was to evaluate the need for specific conservation policies for traditional grasslands.

Figure 1. Typical traditionally managed Dutch grassland with a mixture of grasses and clovers.

2. Experimental design

According to the resident farmers of the identified traditional grasslands, no resowing had occurred with commercial cultivars and no high doses of nitrogen had been applied over the last 40 years. From the group of 50 traditional grasslands, 16 were selected for the present study, representing different soil types and geographic areas (Figure 2).

In addition, reference cultivars of perennial ryegrass (8), white clover (7) and Kentucky bluegrass (11) were included in the study in order to enable comparison of the diversity observed within the traditional grasslands with the diversity present in cultivars that together have played an important role in Dutch grassland cultivation during the last 50 years.

Furthermore, the study included samples from seven Dutch nature reserves in order to enable comparison with the genetic diversity of grasslands that are already under conservation measures and through which genetic diversity can be maintained *in situ*. Like the traditional grasslands, the grasslands from the nature reserves were managed extensively, and covered a similar geographic range (Figure 2). Up to 36 individuals of perennial ryegrass and white clover were studied per grassland population and reference cultivar; for Kentucky bluegrass up to 20 individuals were studied. All samples were characterized by AFLP analysis, a state-of-the-art molecular marker technology allowing detailed genetic comparisons at DNA level (Figure 3). Investigations of perennial ryegrass and white clover also included morphological characterization in a field experiment (Figure 4).

Figure 2. Location of the investigated grasslands. Traditional grasslands are denoted by '•' and nature reserves by ''.*

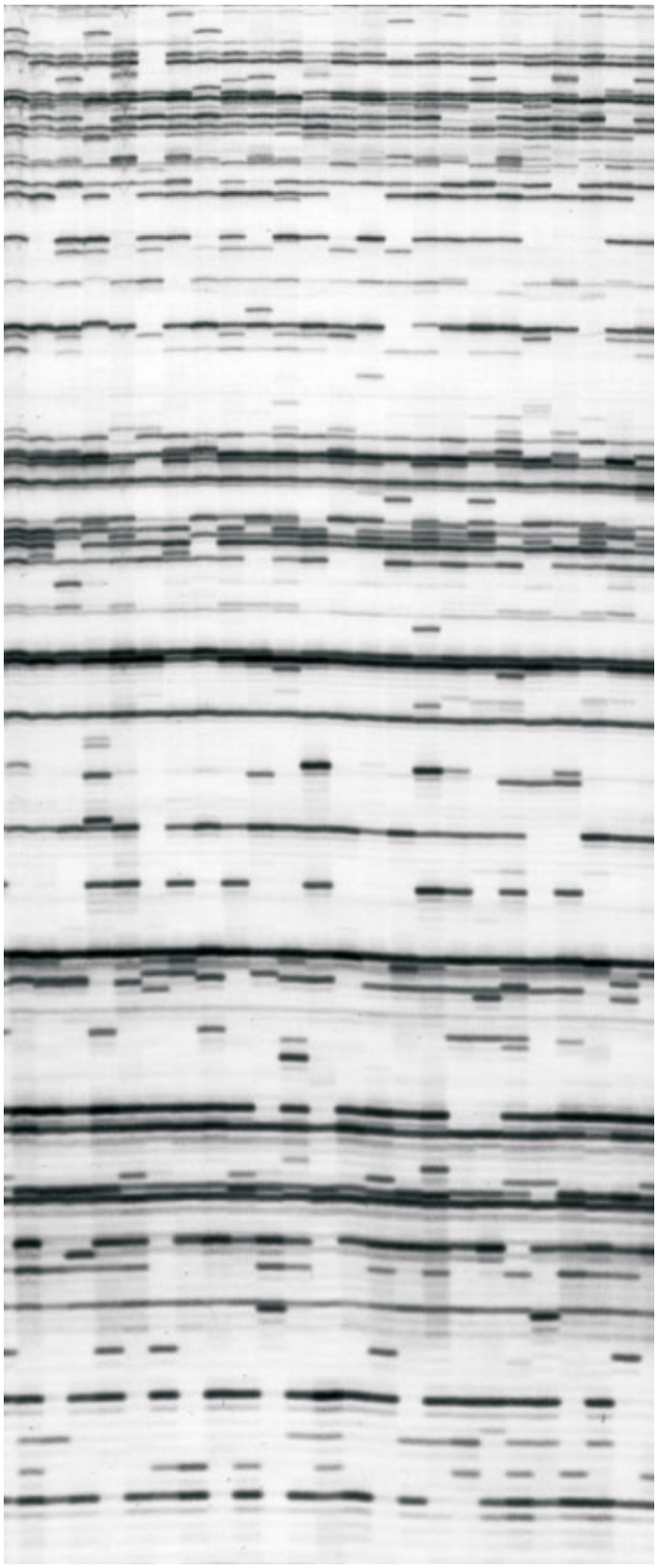

Figure 3. Part of a molecular fingerprint of 24 perennial ryegrass plants (from left to right), each sample consisting of a pattern of AFLP bands (from top to bottom). Samples sharing a specific AFLP band indicate genetic similarity, whereas a difference in band presence indicates genetic distinction.

3. Brief summary of the main results

For all three species, the AFLP data indicated higher levels of intra-population diversity for the traditional grasslands than for the reference cultivars. For perennial ryegrass and white clover this was also observed for the morphological data. Compared to the traditional grasslands, the reference cultivars of perennial ryegrass headed later, whereas those of white clover were more vigorous. These results may be explained as a result of the selection efforts of breeders.
When nature reserves were included in the analyses, it appeared that the major part of the genetic variants observed in the group of traditional grasslands were also found in the group of nature reserves, which was most pronounced for perennial ryegrass and white clover (Figure 5). For all three species, all common genetic variants observed in traditional grasslands were detected in the group of nature reserves as well. Sampling effects and the different number of populations sampled per group are likely to account for the finding that genetic variants observed in low frequency in traditional grasslands appeared absent from nature reserves. Comparison of traditional grasslands and nature reserves indicated that for the three investigated species the two groups basically cover the same spectre of genetic diversity.

Figure 4. Part of the experiment to assess morphological variation in white clover.

4. Policy implications

An accompanying study focusing on the socio-economic perspectives of traditional grasslands indicated that their maintenance is highly threatened in case the farm is sold or the owners are succeeded by relatives (Janssens et al., 2002: Oude graslanden in Nederland: verkenning naar motieven, bedrijfsvoering en perspectieven voor *in situ* beheer. Rapport 3.02.04. LEI, Den Haag). This was confirmed by the present study since between 2000 and 2005, 4 out of the 16 investigated traditional grasslands were given another destination by the new owners. Without conservation measures, traditional grasslands will probably disappear in the long run considering their continuing decrease in number. Hence, the question was whether a comprehensive diversity study in the three key species of grasslands could provide justification for the development of conservation measures.

It has been suggested that conservation efforts should foremost focus on genetic variants that are typical of specific populations adapted to particular agro-ecosystems. However, it appeared that traditional grasslands and grasslands from nature reserves basically cover the same spectre of genetic variation. Because the grasslands located in nature reserves are already under protective measures, no specific *in situ* conservation measures are currently justified to maintain the genetic diversity of perennial ryegrass, white clover and Kentucky bluegrass occurring in traditional grasslands.

It can be questioned whether the results obtained for perennial ryegrass, white clover and Kentucky bluegrass also apply to other species, in particular species that can be expected to exhibit high levels of genetic differentiation. However, this is considered rather unlikely because reproductive behaviour is a key factor influencing population differentiation and because the three investigated species differ considerably in that respect.

In this context, it should be noted that in the present study only genetic diversity within species was addressed, whereas conservationists may consider other aspects of biodiversity, such as species diversity, focussing on rare species for which traditional grasslands may form a refuge. The fact that soil types, management practices, acreages, and geographic distribution of traditional grasslands and nature reserves converge, suggests that such species are likely to have an equal survival probability in nature reserves as in traditional grasslands. These considerations lead to the conclusion that specific measures to maintain traditional grasslands can neither be warranted for conservation of within-species diversity nor for conservation of between-species diversity.

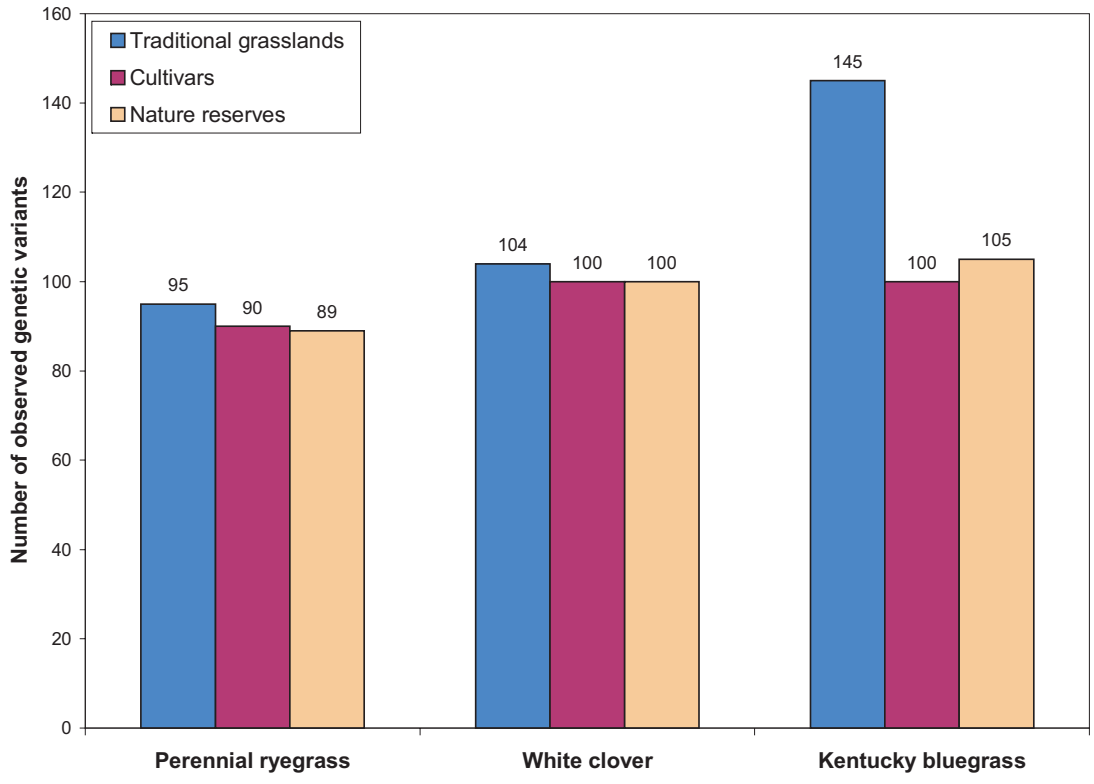

Figure 5. Number of genetic variants observed for the three species studied in the group of traditional grasslands, together with the number of these genetic variants also detected in the group of reference cultivars and nature reserves.

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Colophon

The Centre for Genetic Resources, the Netherlands (CGN) conducts, on behalf of the Dutch government, statutory research tasks associated with the genetic diversity and identity of species that are important for agriculture and forestry. CGN is an independent research unit within DLO Foundation that assists the government in its statutory tasks. Its activities are aimed at the *ex situ* conservation, support for *in situ* conservation, and promotion of the use of genetic propagation material in support of breeding and research, and as part of our bio-cultural heritage. Policy support of the Dutch government and international organizations is provided as a complementary activity. The programme concerns crops and forest species as well as domestic animals.

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