Timothy – the saviour of Icelandic agriculture?

Áslaug Helgadóttir and Thóroddur Sveinsson

The Agricultural University of Iceland, aslaug@lbhi.is

Introduction

Timothy (*Phleum pratense* L.) is the most important forage grass in Icelandic agriculture. No other species matches it when we simultaneously look at such factors as yield ability, feed quality, palatability and persistence (e.g. Sveinsson 2001). Timothy is a naturalized species in Iceland (Stefánsson 1948) and its distribution is mostly limited to cultivated pastures, roadsides and residential areas. Even though timothy was first included in agricultural experiments already in 1898 (Friðriksson, 1956), it wasn't exploited in agriculture until much later, as winter hardy and persistent cultivars were lacking. The cultivars Grindstad (from Norway) and Øtofte (from Denmark) were first imported in 1955 (Óskarsson, unpublished data) but they showed poor winter survival and soon disappeared from the market. It wasn't until Engmo from Troms in Norway arrived on the scene in 1962 and later the two Icelandic cultivars, Korpa (in 1970) and Adda (in 1982), that farmers began to enjoy the benefits of timothy. Since then it has steadily grown in popularity and now completely dominates the forage seed market.

In this paper we will attempt to shed light on the role that timothy has played in the development of agricultural production in the country over the years. We will speculate whether recent advances in milk production can be contributed to its presence in the feed production system. In our speculations we will make use of the statistics collected through the centralized milk recording system by the Farmers Association and Agricultural Authority of Iceland. However, it is important to point out that these statistics are not altogether comparable and therefore our findings will only be indicative rather than conclusive. We will also look briefly at novel uses of timothy in modern multifunctional agriculture.

Agriculture in Iceland in a historical light

The development of agriculture in Iceland from the time of the settlement in the late ninth century to the present day can be divided into five distinct phases which are reflected in the production of farm produce (Figure 1):

I: 900-1900 Self-sufficiency
For centuries sheep husbandry was the main farming activity in Iceland and productivity was very low. Hay was made up of indigenous species obtained from wild pastures and bog lands. It has been estimated that the country could carry 360 thousand sheep by utilizing grazing all year round and hay obtained from bogs in more difficult years. This was sufficient to maintain a population of 60 thousand (see Guðbergsson 1996).

II. 1900-1945. Cultivation begins
The growing urban population created a market for agricultural products. Food security was the major political driver for agriculture. Farmers adopted new but primitive technology in hay making and in improvements of hay fields. Artificial fertilizers arrived on the scene.

III. 1945-1980. Technological advances, increased production
After the end of World War II the rural population decreased rapidly and a subsidy system was set up to reward increased production. Advanced machinery was imported to reclaim new agricultural land. Agriculture was driven towards extensive cultivation of grassland seeded with introduced non-adapted grass cultivars and greater intensification with the use of

artificial fertilizer and concentrates. Unfavourable climatic conditions in the 1960's caused severe winter kill in cultivated grasslands in many parts of the country.

IV. 1980-1995. Production restrictions
Overproduction, particularly in the sheep sector, called for revision of the extensive subsidy system. A quota system was introduced and farmers had to adapt to production limitations. A complete revision of the legal framework for agricultural policies was carried out in 1985. The main objectives were "to promote structural adjustment and increase efficiency in agricultural production and processing for the benefit of producers and consumers and to adjust the level of production to domestic demand and secure sufficient supply of agricultural products as far as practicable at all times" (Thorgeirsson 1996).

IV. 1995-2006. Improved efficiency
Food habits are changing and the proportion of local agricultural products in the total food budget becomes progressively lower. The drive is now towards maintaining margins by reducing inputs as well as by increasing outputs. Dairy and sheep production is steady but the number of "traditional" farms is declining, especially in the dairy sector. Increasing urban demand for rural estates is causing a significant rise in farmland prices. Farmers and other landowners are looking to alternative land uses in addition to food production and agriculture becomes progressively more multifunctional.

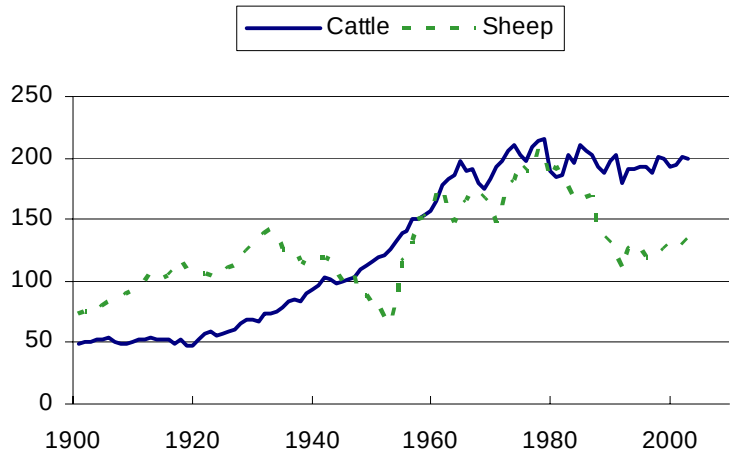

Figure 1. Relative changes in cattle and sheep production from 1901-2003. Volume index 1945=100.

Cultivation of grass fields

Cultivation of grass fields closely reflects the changes in agricultural production over the last 100 years. It commenced following legislation by the parliament in 1923, which provided support to farmers for the cultivation of new undisturbed land or drained bogs (Figure 2). The legislation coincided with the first importation of artificial fertilizer. The development was slow initially but advanced rapidly following World War II, when modern machinery arrived on the scene. It reached a maximum around 1965 (6000 ha yr^{-1}) but then began to slow down again, reaching a low point of around 800 ha yr^{-1}, according to records, when public support ceased in 1992. No state official records are thus available after that time. However, by estimating the extent of cultivation of grass fields from the imports of herbage seed, using the recommended seed rates, it can be seen that cultivation has increased substantially since 1995

compared to the situation just before 1990. In the early years the emphasis was on reclaiming new land for hay or silage, especially on drained bog land, rather than field renovation. Such land reclamation has completely ceased and from 1980 new cultivation has almost entirely been renovation of old cultivated grass fields.

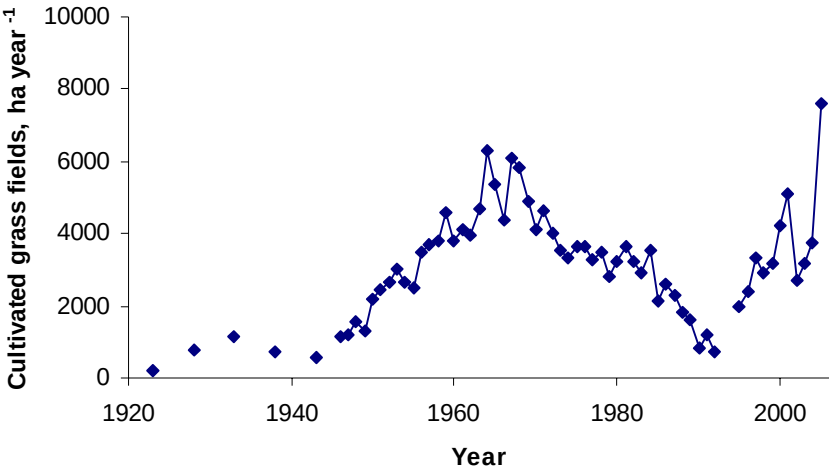

Figure 2. Annual cultivation of grass fields in Iceland 1921-1992 (from Helgadóttir 1996) and estimated area of cultivated grass fields 1995-2005, based on information on seed importation from the Agricultural Authority of Iceland.

Timothy in farmers' fields

Limited information is available on the exact forage species sown in the early days. However, sowing a mixture of several species was recommended, including timothy, meadow foxtail (*Alopecurus pratensis*), meadow grasses (*Poa pratensis*), fescues (*Festuca rubra*, *F. pratensis*), tufted hair-grass (*Deschampsia caespitosa*), perennial ryegrass (*Lolium perenne*) and even floating foxtail (*Alopecurus geniculatus*). The first records of seed imports from 1930 show that timothy and meadow foxtail each made up 35% of the recommended mixture. These two species seem to have dominated the seed mixtures, judging from advertisements from the seed merchants, but it wasn't until 1971 that detailed records became available on actual seed imports. Assuming a seed rate of 20 kg ha^{-1} for timothy it can be estimated that this species made up 40-60% of the total area sown in 1971-1990.

A detailed survey carried out on the species composition of Icelandic grass fields in 1990-1993 showed that timothy was the third most common species, judging either from the proportion of fields where it was found or from the average ground cover (Thorvaldsson 1994). The occurrence of timothy was, however, strongly dependent on geographic location, moisture content, degree of winter damage, elevation and not least the age of the sward. Thus it made up 60% of the ground cover in first year leys, 34% in fields between 2-5 years and 10% or less in fields older than 10 years.

Looking at seed imports from 1995 the amount of timothy has been steadily increasing and it can be estimated that timothy has made up 75-85% of the total area sown with forage grasses. This period warrants a closer look as the emphasis has been on improved efficiency of production. Judging by the renewed interest in the cultivation of grass fields (see Figure 2) it might therefore be worth exploring what role timothy has played in this development.

The contribution of timothy to recent advances in milk production

Big changes have been taking place in the Icelandic dairy sector over the last 10 years. After a long stagnation in total milk production there is an increased domestic demand for processed milk products calling for an increase in the production of fresh milk. At the same time there has been a big reduction in the number of dairy farmers but milk production per milking cow has, on the other hand, been increasing steadily (Figure 3).

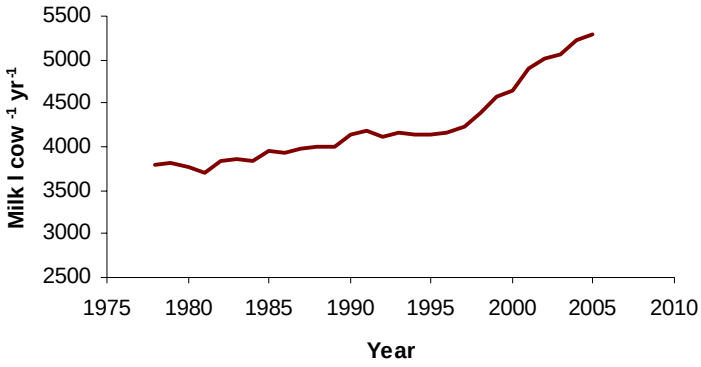

Figure 3. Annual average milk production per milking cow in Iceland as it appears in the milk recording system from 1978-2005 (Baldur H. Benjamínsson, personal communication).

There may be several explanations for a higher milk yield per animal. First, the digestibility of conserved feed has been steadily improving since around 1980 (Figure 4). The main reason for this is that farmers are harvesting the primary grass growth earlier (i.e. less mature) than before and, hence, the feed has a higher dry matter digestibility (DMD). Bale ensiling that was introduced in the late 1980's made this change possible and wilted round bale silage has since become the dominant curing method in Iceland.

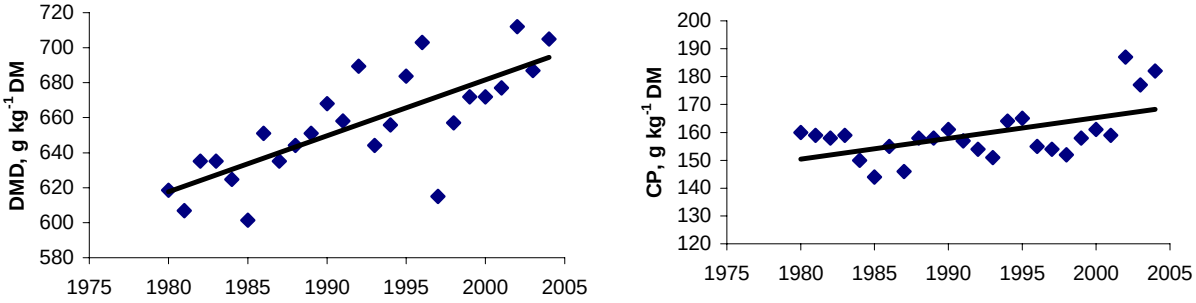

Figure 4. Mean digestibility (DMD) and mean crude protein (CP) of hay and silage samples from farms in north-east Iceland 1973-2004 (Gudmundur Helgi Gunnarsson and Thoroddur Sveinsson, personal communication).

The high feed values obtained after 1995 can without doubt be explained by the renewed interest in field renovation, where timothy plays a dominating role. Timothy has a clear quality advantage over other common grasses in Icelandic grass fields with a mean DMD of 726 g kg^{-1} DM compared to 679 g kg^{-1} DM from an old grass field with a mixture of indigenous grasses (based on results from experiments carried out over a 20 year period at

Korpa Experimental Station, see Helgadóttir & Hermannsson 2001). A series of Icelandic studies on the palatability of forage species for dairy cows revealed the superiority of timothy if harvested before mid heading (Sveinsson *et al*. 2001, Sveinsson & Bjarnadóttir 2006). These experiments recorded daily voluntary DM intake of timothy-based diets between 2.9-4.6% of live weight depending on the lactation stage and age of the cows. No other grass species tested could match this intake.

Secondly, barley grain production on dairy farms has been increasing steadily in the country from 1992 as a result of successful research and breeding of local cultivars (Figure 5). In summer 2005 barley was for example grown on 3600 ha by two thirds of all dairy producers (Hermannsson & Björnsson 2005). The use of concentrates has thus been increasing significantly by farmers over this period even though part of the increase can also be explained by increased importation of concentrates. It should be pointed out that extensive barley cultivation calls for a systematic crop rotation and that in itself ensures better quality of feed obtained from farmers' fields and in this timothy plays a major role (Helgadóttir & Hermannsson 2001).

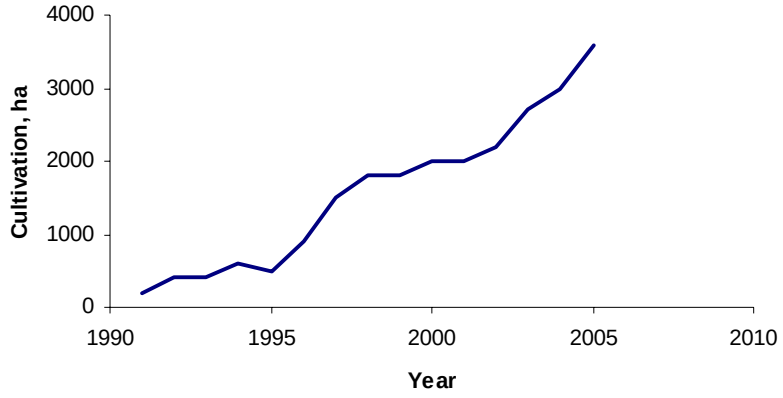

Figure 5. Annual cultivation of barley from 1991-2005.

Thirdly, increased milk yield per cow is also due to some extent to genetic gains in the local cattle populations. However, that discussion is outside the scope of the present paper.

Timothy as a feed for an ever-increasing horse population

Horse breeding for pleasure riding is presently a significant part of Icelandic agriculture. The urban horse population is becoming larger every year and demands quality feed. The Icelandic horse was brought from Norway 1100 years ago and has lived in isolation to the present day. It has adapted to a cold climate and survived harsh winters on poor fodder. It could be argued that the Icelandic horse has developed superior ability to digest and utilize roughage as a result of natural selection. And, indeed, horses have traditionally been given the poorest fodder on the farm. However, a recent study has shown that timothy can be considered a desirable feed for riding horses, especially if cut around the middle of July about two to three weeks after heading and made into wilted silage (Ragnarsson 2004). Such fodder seems to adequately fulfil the energy and protein requirements of active riding horses. Already, farmers specializing in fodder production for the urban horse market have adopted this forage system with good results.

Conclusions

Timothy did not become a real option for farmers in Iceland until winter hardy cultivars generally became available on the market around 1970. After that time it was used extensively for the establishment of new grass fields. However, its superior yield and quality over other forage species was not fully realized as grass fields were rarely renovated and timothy persisted poorly in permanent pastures. It is only in the last 10 years, partly with the advance of barley cultivation, that farmers are enjoying the benefits of timothy in their fields. The cultivation of barley calls for systematic crop rotation and timothy is the best option for leys lasting 5-6 years. Progressive dairy farmers have realized the importance of producing quality fodder and timothy certainly plays a significant part in the advances in milk production obtained over the last decade.

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