

SECTION 3

The Effects on Grass Yield, and Their Implications for Dairy Farming

3.1. Introduction

In this section, we test the temperature–hay yield model developed in Section 2, using the long-term measurements on permanent grasslands from experimental stations in Iceland. Data on national average hay yield, used in Section 2, are only an indirect measure of grass growth, however. Here, and following some preliminary investigations (Björnsson, 1975, 1984), estimates of the effects of climatic variations are refined to consider the yield response to varying fertilizer applications and management practices under different temperature scenarios. Estimates of grass growth are made for five of the six scenarios described in Subsection 1.10:

- (1) Scenario I – the baseline period (1951–1980).
- (2) Scenario II – the coolest recorded decade (1859–1868).
- (3) Scenario IV+ – the ensemble of the 10 warmest years (1931–1984) slightly modified to give a warm anomaly comparable with the cool anomaly in Scenario II.
- (4) Scenario V – the GISS-derived $2 \times \text{CO}_2$ scenario.
- (5) Scenario VI – the extreme year scenario, defined as a year in which mean annual temperature deviates by at least two standard deviations from the period average (*see* Subsection 3.4.1).

Finally, the implications of these effects for the quality and utilization of herbage are examined with respect to Icelandic dairy production.

3.2. The Experimental Material

3.2.1. The long-term fertilizer experiments

Long-term fertilizer experiments have been carried out at four experimental stations in Iceland, located in each quarter of the country. Basic climatic data for the nearest meteorological stations are given in *Table 3.1*, together with data from the meteorological station at Stykkishólmur. The location of all stations are shown in *Figure 1.7*.

Table 3.1. Climatic characteristics (mean for 1951–1980) of experimental stations in Iceland.

Station	Mean temperature (°C)			Mean annual precipitation (mm)
	January	July	Year	
Akureyri	−2.1	10.4	3.4	474
Reykþólar	−1.4	9.8	3.5	552
Sámsstadir	−0.4	11.3	4.8	1261
Hallormsstadur (near Skriduklaustur)	−1.6	10.4	3.6	679
Stykkishólmur	−1.3	9.9	3.7	704

A number of fertilizer experiments on permanent hayfields were initiated at the experimental stations in about 1950, and many of them have been continued up to the present. These experiments include rates of application of nitrogen (N), phosphorus and potassium, comparisons of N fertilizer types, liming experiments, etc. The experiments were laid out on silty loam and newly reclaimed peaty soils. The vegetation was either a mixture of indigenous grasses, including common bent (*Agrostis capillaris*), tufted hair-grass (*Deschampsia caespitosa*), red fescue (*Festuca rubra*) and smooth meadow grass (*Poa pratensis*), or a mixture of sown and indigenous species, where meadow fox-tail (*Alopecurus pratensis*) was the most commonly used sown grass. All experiments were managed similarly. They were fertilized in spring, cut for hay once or twice in the summer and protected from grazing animals.

For the present study, experiments were selected in which fertilizer treatments had been constant for a decade or more. Account needed to be taken of variations in harvesting practices in the experiments, both between the experimental stations and between years at individual stations, with respect to number of harvests and harvest dates. At Sámsstadir the experiments have, with just two exceptions, been harvested twice a year. The yields from these two anomalous years were omitted together with the yield in the following year, when residual effect of the deviant cutting treatment can be expected. The experimental station at Akureyri was moved to Möðruvellir, 18 km further north, in 1974. This was followed by a reduction in the number of experiments. The old experiments, located at Akureyri, were only harvested once a year rather than twice, as previously had often been practiced. Other variability in harvesting practices at the four stations is partly due to changes in management