Potassium supplied by precipitation and its possible role in forest nutrition

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SUMMARY

Published data on potassium content of precipitation for eight Irish meteorological stations over a period of seven years were processed to give the quantities supplied. The overall distribution is concave, with lowest values in the central area and the highest on the west and northwest coasts. The average quantity supplied ranged from 1.6 to 11.7 kg K/ha per annum. It is suggested that this supply may be important in soils of low K supplying power.

Introduction

Severe growth check due to potassium deficiency has been observed in forest crops on certain peat sites in the Irish midlands (O'Carroll 1966, 1972a, 1972b). Mild to moderately severe foliar deficiency symptoms have been observed on western and north western blanket bog peats, but no cases of severe growth check which could be ascribed to potassium deficiency have so far come to light.

Procedures

The Meteorological Service of the Department of Transport & Power has since 1962 recorded and published (in the Irish Monthly Weather Report) data on various inorganic constituents, including potassium content, of precipitation at 8 stations (Fig 1). Details of analytical methods are given by Tierney (1967). Data on potassium for the years 1965—1971 have been processed to give the quantities of potassium supplied by precipitation at each of the eight stations. The annual quantities are shown in Table 1 and have been tentatively converted to isopleths (lines of equal quantity) (Fig. 1) although these must be treated with reserve in view of the small number of stations involved.

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Data for two stations, Belmullet and Birr, representing areas of high and low potassium supply have been given in greater detail. Fig. 2 shows the monthly averages for the seven years studied. Fig. 3 shows the average precipitation and the average potassium concentration over the same period for the same two stations.

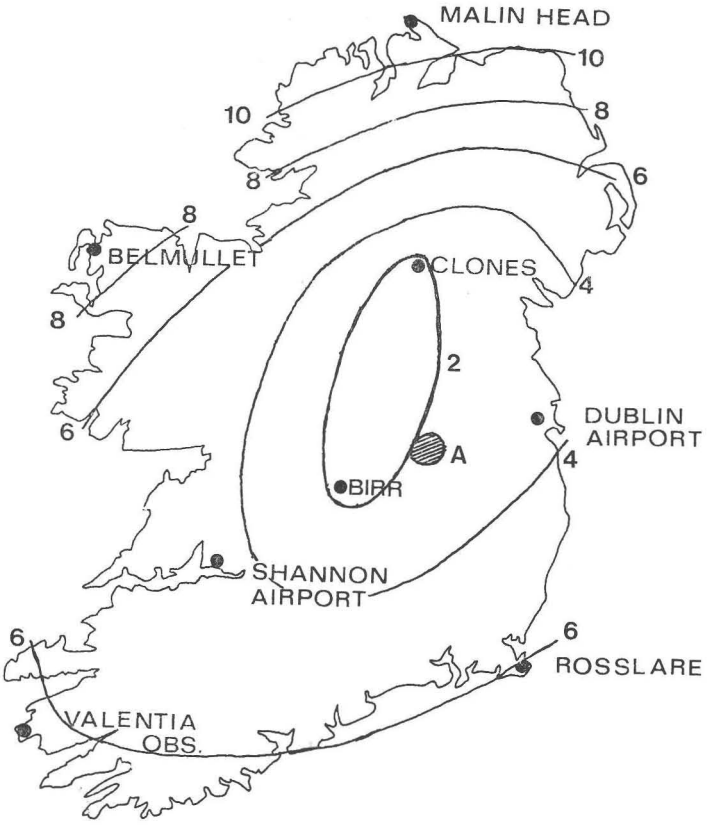

Figure 1

Location of meteorological stations and isopleths of potassium supplied in precipitation (kg/ha).
A—Area of known severe potassium deficiency.

Discussion

The general pattern of potassium supply as seen in Fig. 1 appears to be concave, with lowest values in the central part or

the country. Quantities supplied increase rapidly towards the north west, and more slowly towards the coast in the other directions.

No detailed survey of the occurrence of potassium deficiency in Irish forests has been carried out, but one area where severe deficiencies do occur is that marked A in Fig. 1. Severe deficiencies have not been observed in blanket bog areas in the west and north west where studies in forest nutrition have been in progress for about 15 years.

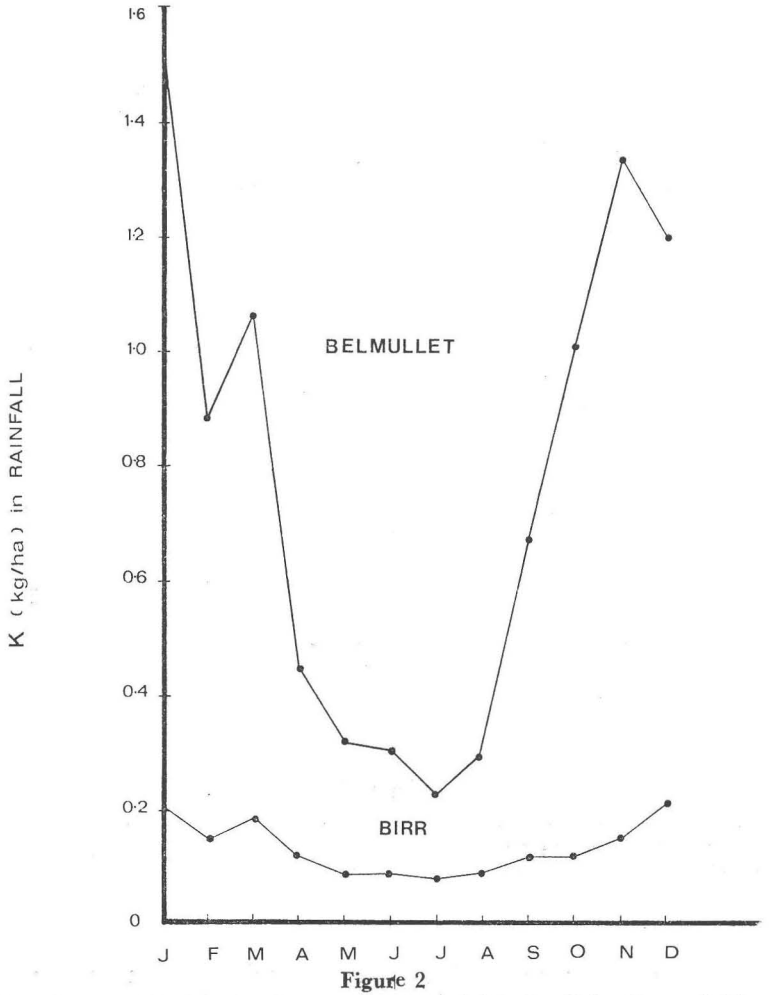

Figure 2

Average monthly supply of potassium in rainfall for Belmullet and Birr (1965—1971).

The practical significance of a supply of potassium varying from 1.6 or less to nearly 12 kg/ha per annum in terms of forest nutrition cannot be determined in the absence of information on both the potassium requirements of our crops and the potassium supplying power of our forest soils. Data assembled by Switzer and Nelson (1972) on young loblolly pine may give some

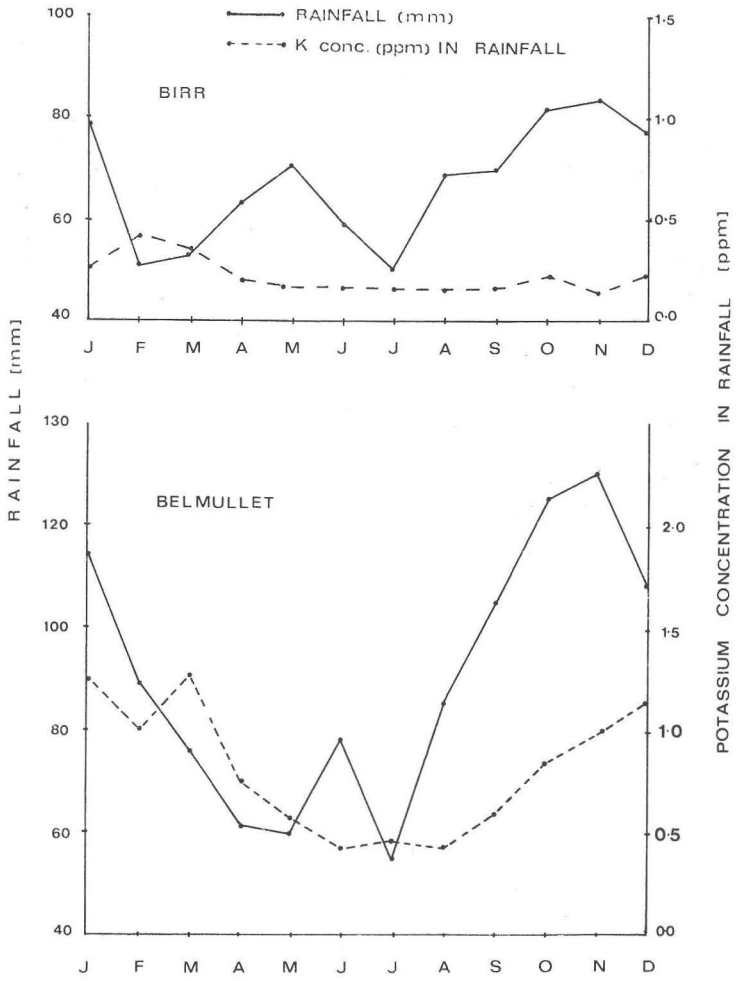

Figure 3

Average monthly rainfall and its potassium concentration for Belmullet and Birr (1965—1971).

indication of the order of quantities involved. They report that between the ages of 5 and 20 years, the annual incorporation of potassium into the above-ground (including litter) fractions of the plantation ecosystem varied from 4 to 7 kg/ha. The highest rate of incorporation occurred between 5 and 10 years, with a drop of nearly 50% in the 15 to 20 year period. It is clear that for such a crop on a soil deficient in available potassium, a variation of from 2 to 12 kg/ha of potassium supplied in precipitation could be critical. Unlike soil potassium, that derived from precipitation is entirely available although some may be lost in runoff.

These indications are supported by data of Ovington (1965) who reported average annual accumulations of 4 to 7 kg/ha of potassium in 47 year old crops of Douglas fir, Scots pine, Norway spruce and pedunculate oak in England. The same author gives data for a 55 year old Scots pine stand where the maximum annual accumulation of potassium in trees, ground flora and litter was 17 kg/ha, the average for the whole 55 year period being 6 kg/ha per annum.

Monthly variations for two stations are shown in Figs. 2 and 3. A seasonal contrast exists in supply in Belmullet with its maximum of 1.5 kg/ha in January, and its minimum of 0.23 kg/ha in July.

In Birr, on the other hand, the values are uniformly low, less than 0.20 kg/ha, throughout the year.

The seasonal contrast at Belmullet may be due to the higher winter rainfall at that station, allied to the close relationship between potassium concentration and the amount of rainfall. (Fig. 3). No such relationship holds for Birr, the potassium concentration staying relatively constant (.1—.2 ppm) irrespective of the amount of rainfall.

REFERENCES

O'Carroll, N. 1966. Growth check of Norway spruce and Scots pine due to potassium deficiency. **Irish For.** 23, 36—41.

O'Carroll, N. 1972(a). Chemical weed control and its effect on the response to potassium fertilization. **Irish For.** 29, 20-31.

O'Carroll, N. 1972(b). Improvement of unsatisfactory crops. Reed swamp peat. In **Forest Research Review 1964-70** Stationery Office, Dublin p 60.

Ovington, J. D. 1965. Nutrient cycling in woodlands. In E. G. Hallsworth and D. V. Crawford (Eds.) **Experimental Pedology** Butterworths, London 208-215.

Switzer, G. L. and Nelson, L. E. 1972. Nutrient accumulation and cycling in loblolly pine (**Pinus taeda** L.) plantation ecosystems : the first twenty years. **Soil Sci. Soc. Amer. Proc.** 36, 143-147.

Tierney, S. L. 1967. Atmospheric chemistry in the Irish meteoro'ogical Service and a discussion of some results. **Irish Met. Service Tech. Note No.** 32, 1—15.

TABLE 1

ANNUAL SUPPLY OF POTASSIUM IN RAINFALL (Kg/ha)

Station	Year							
	65	66	67	68	69	70	71	Mean
Birr	2.34	1.89	1.62	1.67	1.05	1.69	1.09	1.62
Clones	2.51	2.77*	1.72	1.34	1.54	1.73	1.43	1.89
Dublin Airport ...	4.11	3.98	3.42	4.93	2.40	2.47	2.01*	3.37
Shannon Airport	5.52	6.30	4.59	3.63	3.14	3.86	4.22	4.47
Rosslare	8.92	8.84	6.19	4.56	4.91	4.63	3.86	5.99
Valentia	9.26	7.39	8.08	5.17	4.31	5.19	4.32	6.25
Belmullet ...	10.63	9.70	10.88	8.50	7.61	9.58	8.31	9.32
Malin Head ...	13.62	15.96	14.37	8.57	10.41	11.18	7.92	11.72

*Data not available for Clones, May 1966 and Dublin Airport, March 1971.