

Spruce Growth Rates on Drumlin Soils

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INTRODUCTION

Of the many topographic features left to us by a departing Ice Age, one of the most outstanding is that characterised by the numerous small oval-shaped hills located mainly on the North-Central plains. These hills called drumlins (from the Irish *druim* meaning a mound or rounded hill) also occur in small areas in other parts of the country notably around Clew Bay and in Clare, but the great belt of drumlins stretching from southern Donegal and Sligo through Fermanagh, Leitrim, Cavan, Louth, Monaghan, Armagh and Down is one of the largest in the world. Drumlins were formed under moving ice and this is the reason claimed for their long low streamlined shape.

Gardiner and Ryan (1969) state that drumlin soils occupy 10.1% of the Republic, of which 7.8% are wet mineral or organic soils; only 2.3% are classed as mainly drier mineral soils. The discussion of spruce production on drumlin soils which follows, is confined to the wet mineral soils with particular reference to the Leitrim-West Cavan area.

GENERAL DESCRIPTION OF AREA

Definition

Embelton and King (1968) define a drumlin as: "a low hill having an oval outline and not exceeding 60m in height. It is formed mainly of till, but sometimes contains stratified material or a rock core."

Geology and Drift Origin

Most of the soils of the drumlin area have developed from sedimentary rocks. In the North Leitrim lowlands, calcareous carbon-rich shale is the dominant parent material, while in South Leitrim siliceous limestone and shales are the predominant soil parent material. In the Cuilceagh mountains, sandstones and grits are the commonest parent materials. The drifts formed from these rocks are generally high in silt and clay and provide the material for the typical Leitrim "daub". Cruikshank (1961) implies that the movement of drift material from its parent rock has been negligible in most areas in Fermanagh and this holds for the Leitrim-Cavan area also.

Soils

The soils of the drumlins are typically heavy soils high in silt and clay, with poor subsoil structure and aeration. In the western

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areas of the drumlin belt, where the rainfall is higher, this leads to the formation of gley soils; sometimes locally called "daub" soils. East of County Cavan, where rainfall is less and soil parent material is somewhat more favourable, the soils have moderate to poor drainage. An increase in elevation, with its consequently increased rainfall, brings the development of peat, giving firstly peaty gleys and finally climatic peats on drumlin topography. This is typical of the Drumkeeran area where a drumlin landscape is covered with a thin skin of peat at elevations above 500 feet.

The typical gley has a surface layer rich in organic matter overlying a compacted plastic subsoil of blueish or greyish colour. Roots are normally limited to the organic layer. The dense plastic subsoil, low in pore space and impermeable to water, combined with all-the-year-round rainfall greatly in excess of evaporation (Mulqueen and Burke 1967) ensures that these soils are waterlogged for most of the year. Mapping of these soils is extremely difficult and very complex patterns emerge.

For the Leitrim-Cavan area a number of generalisations may be made about soils in a drumlin topography; the first is that the soils on the drumlin itself normally differ from those on the interdrumlin areas; secondly, drumlin soils can be segregated on the basis of slope, and finally, interdrumlin soils can be segregated on the nature of the soil material developed.

Drumlin Soils

In the wetter areas of the drumlin belt typified by County Leitrim, a 3-8 inch organic-layer overlies a plastic subsoil. Soils on the flat tops of drumlins and on the lower, more gentle slopes tend to be poorer, possibly with a skin of peat, than those on the sides (Lee and Ryan 1965, Jaritz and Lee 1968, Finch and Lee 1969). In the limestone areas of South Leitrim and West Cavan, a variation of the above soil, which has a hard-banded layer of chert gravel below the organic layer, occurs. The chert layer may be from a few inches to nine inches thick and is underlain by the heavy daub subsoil. Locally, this layer of chert is known as "channel". Rooting in either the daub or channel soils is limited to the thin organic-rich layer. Because these soils are normally waterlogged, and have a high silt and clay content and poor structure, they have a low bearing capacity, and are easily damaged by cattle treading or machinery movement.

Interdrumlin Soils

Soils occurring in the interdrumlin areas account for one fifth to almost half the total land surface in a drumlin topography; they generally average about one third of the area. Normally all are poorly drained to waterlogged for most of the year. They can be divided into three main types depending on local circumstances; where a stream of any size occurs, alluvium may be found; in depressions

with no outlet peat may form, and finally a mixture of the two previous soils may form an organo-mineral soil.

Because infiltration of rainfall into heavy drumlin soils is slow, surface run-off of rainwater, particularly in heavy rain, is high. The run-off, carrying clay particles downslope, mixes with overflowing streams and deposits a colluvial-alluvial mixture on the interdumlin flats. In flat areas, where water tends to stagnate, peat begins to form and a peat-alluvium mixture, of varying proportions of organic matter develops. Where continuous ponding of water takes place, peat formation becomes the dominant soil process; in the limestone areas a base rich *Phragmites* peat, that gives a rich free-draining soil when properly handled, develops, while on the more acidic shale or sandstone parent materials, a rawer more oligotrophic peat develops.

The first state afforestation of drumlin soils was in the middle thirties and figures shown in this paper are from plantations planted from then up to 1957.

METHODS

Conifer crops rated as high forest, and planted before 1958 were included in the 1968 Inventory of State Forestry. These crops were classified by yield class and these data are used here to show the production from drumlin soils. The forest areas in Leitrim, West Cavant and on the Roscommon-Leitrim border were checked against topographical maps, and the forest properties likely to be on drumlin were listed. These properties were checked in the field and the sub-compartments or compartments on drumlin soils noted. The yield classes used are those of the Forest Management Tables (Bradley, Christie and Johnson, 1966) for Sitka spruce and Norway spruce.

Production from State Forests

Most of the plantations in the areas which are covered by this inventory are on peats, peaty gleys, brown podzolics and alluvium leaving about 850 acres (344 ha.) of Norway and Sitka spruces on drumlin soils. The forests represented, and the areas involved, are shown in Table 1.

TABLE 1

Forest	Sitka spruce acres (hectares)	Norway spruce acres (hectares)
Drumsna	53 (21.5 ha.)	205 (83.0 ha.)
Dromahaire	6 (2.5 ha.)	— — —
Glenfarne	37 (15.0 ha.)	31 (12.5 ha.)
Killeshandra	218 (88.0 ha.)	297 (120.0 ha.)
TOTAL	314 (127.0 ha.)	533 (215.5 ha.)

Table 2 shows the area in each yield class of the two spruces. (The metric yield classes are cubic metres per hectare per annum).

TABLE 2

Yield Class Hoppus measure (metric equivalents in brackets)	Sitka spruce		Norway spruce	
	Acres	%	Acres	%
100 (8.9)	— — —		3 (1.0 ha.)	—
120 (10.7)	— — —		9 (3.5 ha.)	2
140 (12.5)	— — —		7 (3.0 ha.)	1
160 (14.0)	2 (1.0 ha.)	1	4 (1.5 ha.)	1
180 (16.0)	15 (6.0 ha.)	5	59 (24.0 ha.)	11
200 (17.8)	69 (28.0 ha.)	22	100 (40.5 ha.)	9
220 (19.6)	29 (12.0 ha.)	9	54 (22.0 ha.)	10
240 (21.4)	82 (33.0 ha.)	26	297 (120.0 ha.)	56
260 (23.2)	77 (31.0 ha.)	24		
280 (24.9)	40 (16.0 ha.)	13		
TOTALS	314 (127.0 ha.)	100	533 (215.5 ha.)	100

The mean yield class for Sitka spruce is 240 (21.4 metric) and for Norway spruce 220 (19.6 metric). These means are the weighted averages taken from the production and area figures in Table 2.

Production from Private Forestry

The authors were fortunate in having access to Mr. A. O'Rahilly's plantations near Leitrim village. These plantations show excellent growth on typical drumlin soils. The measurements taken were confined to Sitka spruce crops in the 15 - 20 age group at Drumhierny and Kilmaherna. While the area assessed is small, it does show the production potential of what is normally considered agricultural land in the region. The results obtained are in Table 3.

TABLE 3

Yield Class Hoppus measure, (metric equivalents in brackets)	Sitka spruce	
	Acres	%
260 (23.2)	4 (1.5 ha.)	10
280 (24.9)	29 (12.0 ha.)	75
280+ (24.9+)	6 (2.5 ha.)	15
TOTAL	39 (16.0 ha.)	100

The weighted mean yield class here is 280 (24.9 metric) which is the top yield class given in the management tables.

The yield classes of the Forestry Commission management tables are designed to incorporate three production classes, A, B and C. Production class B is the equivalent of the general yield class, production class A is a yield class above and production class C a yield class below the general yield class. Thus yield class 240, production class A, becomes the equivalent of yield class 260 though the age/height relationship is that of 240. Recent research work in the Forest Service indicates that Sitka spruce is normally production class A in this country.¹ This means that the mean production figures shown here for Sitka spruce could be assumed to be one class higher viz. 260 for state forestry and 300 for private forestry.

DISCUSSION

Agricultural production on drumlin areas is limited by both poor soils and uneconomically sized holdings. This fact is generally accepted but perhaps the inherent truth of it is best portrayed by the classic response of the people themselves. Emigration is high and population pattern projections indicate that there will be no successor for up to 60% of the farm holdings within the next thirty years (Duke, 1967). The forest potential must be considered against this background of high forestry production figures compared with the marginal agricultural returns. The spruce production figures shown here are certainly above average for the country as a whole and indicate that large scale afforestation of low-lying drumlin soils would provide a high return (by forest standards) on the capital employed, and worthwhile employment.

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