Growth Potential of Poplars in Northern Ireland

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Summary

The development of poplar planting in Northern Ireland is described. Results from an experiment comparing five cultivars (clones) planted in 1977 are presented and briefly discussed. Clones derived from *P. trichocarpa* are recommended as the most reliable and productive until more information becomes available. It is recommended that commercial poplar planting should be initially restricted to sheltered sites below 100m elevation. Soil pH should be above preferably exceed 5.0. It is suggested that, using *P. trichocarpa,* a timber yield of 24m^3/ha/year could be achieved on suitable sites over a 15 year rotation.

1. Introduction

In recent years there has been considerable interest and research undertaken into the development of new poplar *(Populus)* cultivars, or clones, particularly in Belgium, Scandinavia and Canada. Poplar wood is a useful raw material for producing short fibred chemi-thermo-mechanical pulp (CTMP), of which a considerable expansion of production has taken place in Northern Europe and North America (Croon, 1990). Plantations of poplar clones derived from *P. trichocarpa* and *P. deltoides* may achieve greater rates of growth than those based on older, long established clones derived from *P. x euramericana,* however many have not yet been adequately tested under British or Irish conditions (Potter *et. al.,* 1990). The potential of poplars for producing material for pulping in Northern Ireland is of interest, particularly as poplar cultivation could provide an alternative land use to agriculture. This paper summaries the experience of the Forest Service (Department of Agriculture, NI) with poplars, from 1937 to the present.

2. Development of Poplar Planting in Northern Ireland

Before the 1950s the only documented planting of poplars consisted of little more than 10ha planted in 1937 on the 'Bann Dumps', in counties Londonderry and Antrim. These were areas where spoil from dredging operations on the River Bann was dumped. The plantations included and

early clone of *P. trichocarpa*, and *P. x euramericana* 'Serotina'. Inspection in the early 1950s showed that although growth was good, canker (caused by the bacterium *Xanthomonas*) was prevalent. On this basis it was thought that commercial planting would be feasible provided canker resistant strains were used. From 1954 to 1964 about 350ha of poplar plantations were established in both State and private plantations (Phillips, 1964). During the same period collections of poplars were established for comparative purposes, without replication, in 4 and 16 tree sample plots respectively at Roslea, in the southern part of Co. Fermanagh, and near the north coast at Somerset, Co. Londonderry.

A survey of poplar plantations was carried out in 1963. The results, described by Phillips, showed that only 43% were satisfactory in terms of growth, and subsequently commercial planting of poplars virtually ceased. The lack of success of the majority of the plantations was attributed to exposure and unsuitable soil. An experiment comparing five clones, which had been included to a greater or lesser extent in the earlier plantations, was planted at Hollymount, Co. Down, in 1977.

Apart from Forest Service plantations and limited trials and experiments, poplars have been widely used in recent years by local authorities for roadside and amenity planting. Many now are prominent landscape features.

3. Comparisons Between Poplar Clones

3.1 The 1963 Survey

Plantations inspected during the survey included more than 20 poplar clones which were planted on a wide range of soil types and at elevations of up to 300m. Apart from collections at Roslea and Somerset, there were no systematic trials between clones on similar sites, and many of the observations are clearly site dependent. However in the light of later experience some of the details recorded by Phillips may bear repeating.

A general comparison of the performance of clones across all sites is given in Table 1. Most plantations consisted of *P. x euramericana* clones. Of these 20% to 48% were of satisfactory growth, depending on which clone was used; 'Robusta; was marginally the best, 'Eugenei' the poorest and 'Serotina' and 'Gelrica' were intermediate. The majority (56-87%) showed signs of rust, canker or dieback; the occurrence of these disease symptoms appeared to be inversely related to growth differences between clones. Limited evidence suggested that poor growth was also associated with a

soil pH less than 5.0. The North American balsam poplars *P. trichocarpa* 'CF' and *P. trichocarpa x balsamifera* 'TT32' and 'TT37' were planted on a very limited scale. However they performed noticeably better on the sites on which they were planted. 'TT32' was preferable to 'TT37' in terms of lower susceptibility to disease. It has since been renamed 'Balsam Spire' and will henceforth be referred to as such. On this basis, Phillips suggested that satisfactory growth might only be reliably achieved from using the balsams, except perhaps on the best sites on which 'Robusta' could be used. It was also suggested that poplars might have a future in agroforestry systems. In subsequent years it has become apparent that high yielding plantations of *P. x euramericana* clones in State and private forests have only occurred on fertile soils at low elevations in central parts of Northern Ireland, while *P. trichocarpa* and Balsam Spire have grown well in a wider variety of locations.

Table 1: Performance of poplar clones in plantations surveyed in 1963 (after Phillips, 1964).

Clone	Area Planted (ha)	%of Satisfactory Growth	% Diseased	% Survival
P. x euramericana:				
'Robusta'	56.0	48	56	93
'Serotina'	52.0	41	72	95
'Gelrica'	117.6	43	67	94
'Eugenei'	13.8	20	78	60
P. trichocarpa:				
'CF'	4.6	91	18	100
P. trichocarpa x balsamifera:				
'Balsam Spire'	6.8)		0)	
('TT32')	)	87	)	100
'TT37'	4.4)		30)	
Others	74.0	35	–	–

3.2 Poplar collections

A single growth assessment was carried out in 1964 at Roslea and in 1966 at Somerset, when the majority of plots were between 7 and 12 years old. Early height and diameter growth of *P. trichocarpa* clones was best in both collections, while 'Balsam Spire' was better than *P. x euramericana* clones.

Owing to the high failure rate at both locations, no further growth assessments were made. At Somerset remaining plots were cleared after wind damage during the 1970s. At Roslea there are outstanding specimens of the early *P. trichocarpa* clones CF, J2 and T3, and Balsam Spire (TxT32), now more than 30 years old. *P. trichocarpa* Fritzi Pauley has suffered from top damage in storms, while TxT37 has clearly suffered from disease. There are also large specimens of *P. trichocarpa x nigra* Roxbury remaining. The rest of the collection has been largely cleared.

3.3 Hollymount experiment 1/77

The *P. x euramericana* clones 'Robusta', 'Serotina' and 'Gelrica' were compared with 'Balsam Spire', and an unspecified clone of *P. trichocarpa* (probably 'Fritzi Pauley') in an experiment planted in Hollymount Forest, Co. Down, in 1977. The site is almost at sea level, 8km from the coast and sheltered by drumlins. The soil is a ground water gley overlying till derived from Silurian present material. The site is prone to flooding; the water level in drainage ditches suggests a water table depth of about 30cm or less in winter and 70cm in summer. One year old rooted cuttings of each clone were planted in square, nine tree plots at a spacing of 5.5m. There were six replicates. Soil samples were taken at 0-10cm depth in each plot for determination of pH and organic matter content during January 1990. The pH varied from 4.3 to 5.3 between plots. Organic matter content (% loss on ignition) averaged 39%, and ranged from 21.6% to 57.1%. The variation in pH is not related to organic matter content, drainage, from plot levels, or the water table, measured in pits when soil samples were taken.

Growth and survival were assessed at the end of the 1990 growing season, 14 years from planting. Results are summarised in Table 2. There are large differences in height and DBH between clones, with *P. trichocarpa* performing best by a large margin. In plots of 'Balsam Spire' and *P. trichocarpa* mean DBH was derived from measurements of centre trees only to eliminate possible bias arising from greater diameter increment of edge trees. Differences in survival followed the same trends as growth.

Basal area production was calculated from quadratic mean DBH and survival. Stem volume was not assessed. The basal area production of *P. trichocarpa* is 2½ times of the 'Balsam Spire' and nearly 4 times that of 'Robusta' and 'Serotina', which both performed similarly. Similar growth differences between *P. trichocarpa* and *P. x euramericana* clones have occurred in Forestry Commission trials (Jobling, 1990).

Stem lesions caused by canker are prevalent in plots of *P. x euramericana* clones and insignificant in plots of Balsam Spire and *P. trichocarpa*.

Table 2: Comparison of poplar clones in Hollymount experiment 1/77 after 14 years.

Clone	Mean Height (m)	Mean DBH (cm)	Survival (%)	Basal Area (m^2/ha)
P. x euramericana:				
'Robusta'	13.0	18	96	8.5
'Serotina'	12.8	18	91	8.1
'Gelrica'	10.5	15	80	4.9
P. trichocarpa x balsamifera:				
'Balsam Spire'	15.7	22	98	12.7
P. trichocarpa:	18.6	34	100	30.1
Standard error of means	0.68***	1.8***	3.6**	1.88***

** Significant at p = 0.01
*** Significant at p = 0.001

The effect of soil pH on mean height, mean DBH, survival and basal area was investigated using regression analysis. The results, Table 3, showed that it had a highly significant effect in all cases. The relationship between soil pH and mean height in 1990 for different clones ('Robusta' and 'Serotina' combined) is shown in Figure 1.

Table 3: Regression analysis of growth variates and survival in Hollymount experiment 1/77.

Y variate	Variance ratios of model terms		
	Block	Clone	pH
Meanheight	2.6	63.2***	41.7***
Mean DBH	4.9	116.8***	31.4***
% Survival	2.1	7.1**	8.9**
Basal area	4.2	220.5***	34.8***

** Significant at p = 0.01
*** Significant at p = 0.001

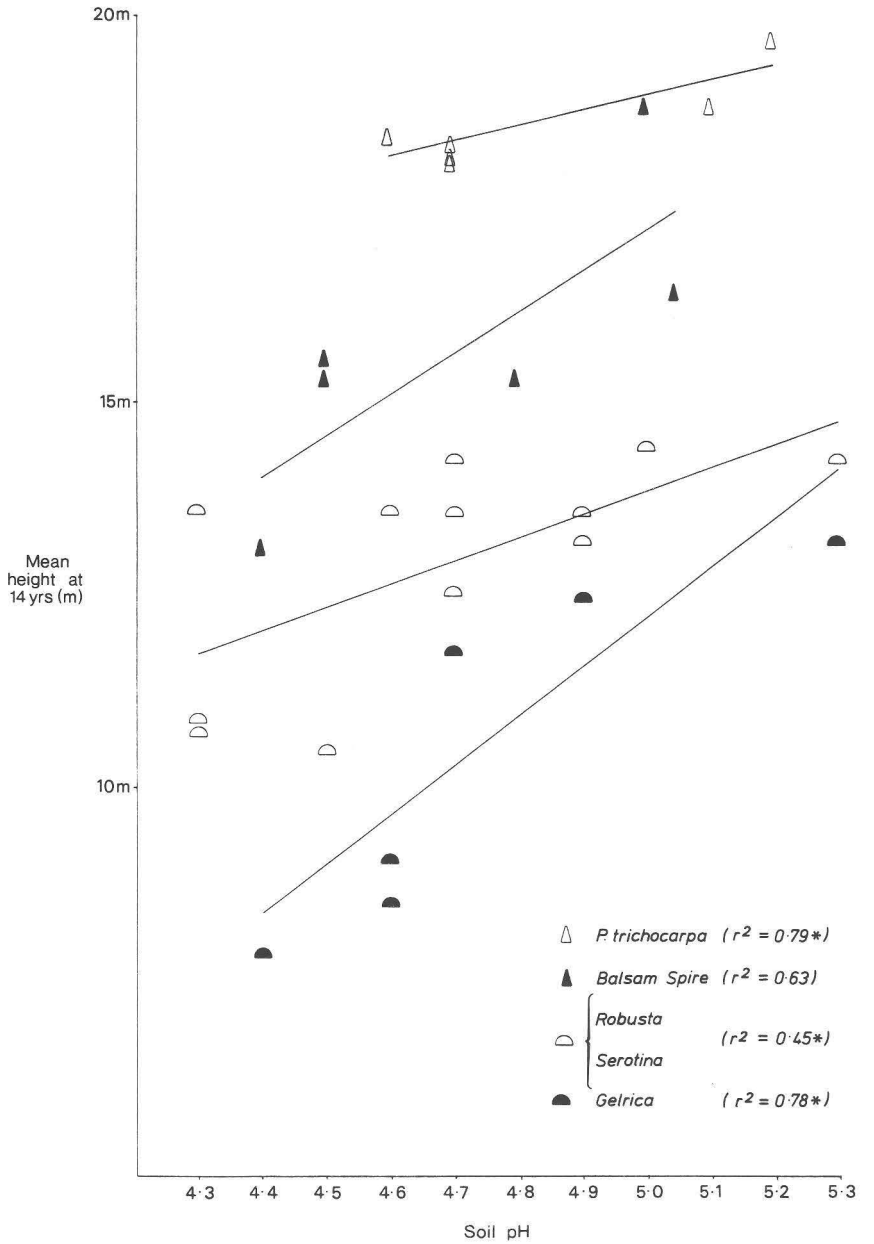

Figure 1: Effect of soil pH on mean height at 14 years of poplar clones in Hollymount experiment 1/77.

4. Site Requirements

The best sites for growing poplars undoubtedly consist of alluvial soils in sheltered river valleys. Shelter, warm summer temperatures, slightly to moderately acid soil (pH 5.0-6.5) and a water table 60cm or more below ground level in winter and 1.5m in summer are listed as important pre-conditions for satisfactory survival and growth in Britain by Jobling (1990) and Evans (1984). However it is clear from observations in Northern Ireland that *P. x euramericana* clones are more exacting in terms of site requirements than clones or hybrids of *P. trichocarpa*. In Britain, Jobling suggests that on the basis of normal summer temperatures, *P. x euramericana* clones are only suitable for use in southern England, while *P. trichocarpa* and 'Balsam Spire' are more suitable for other regions, and can tolerate a soil pH as low as 4.5. In Northern Ireland good growth using *P. x euramericana* clones 'Robusa' or 'Serotina' has only been achieved on ideal sites in central and eastern localities. *P. trichocarpa,* with a natural range which encompasses that of Sitka spruce, is likely to be more tolerant of cooler summers experienced in other areas and at higher elevations, provided exposure and soil pH are not limmiting.

Phillips noted that performance of poplars was markedly reduced at elevations above 120m. Poor performance was also associated with exposure and/or poorly drained soil. On this basis it is recommended that, initially, commercial planting should be restricted to below 100m elevation except on very sheltered sites. Early growth of poplars at Somerset was poorer than at both Roslea and Hollymount. Evidence from examination of the soil and pH assessment suggest that this is due to differences in exposure or other aspects of climate, rather than soil factors.

At Hollymount variation in growth is significantly correlated with soil pH. Growth is best where the pH is 5.0 or greater and is particularly poor at pH 4.5 or less. Growth of *P. trichocarpa* is the least variable (within a pH range of 4.6-5.2), suggesting that it is more tolerant of low soil pH than the others, as suggested by Jobling. There was no relationship between water table depth (or ground level) and growth, although there are indications that the high water table at Hollymount has reduced rooting depth, and will affect stability.

5. Timber Production Potential

Growth assessments at Hollymount at year 14 suggest that *P. trichocarpa* is growing at a rate equivalent to yield class (YC) 14 (Edwards and Christie, 1981). This corresponds to an estimated mean annual increment (MAI) of around 14m^3/ha/yr at the current spacing and age, and a maximum MAI of about 21m^3/ha/yr at age 27. Data from a single assessment in early poplar collections suggest that a lower YC would be achieved in northern locations.

The height and basal area growth of *P. trichocarpa* at Hollymount is similar to that recorded in permanent sample plots and trials at the same spacing at Alice Holt, Quantock and Flaxley, all in south Britain (Christie, 1959; Forestry Commission, 1968, 1969; Jobling, 1990). Timber production is strongly affected by spacing; data from a Forestry Commission *P. trichocarpa* spacing trial at Alice Holt suggest that adopting spacings of either 3.6m or 2.7m could result in increase in timber production of 35% and 60% respectively compared to a spacing of 4.6m (Jobling, 1990). At YC 14 and 2.7m spacing this corresponds to a MAI of 24m^3/ha/yr at 15 years and a maximum MAI of almost 30m^3/ha/yr at between 22 and 27 years (Edwards and Christie, 1981). This rate of timber production would exceed that of any other forest tree species grown in Northern Ireland. Close spacing would also be more appropriate for producing pulpwood.

6. Conclusions

Experience to date suggests that clones of *P. trichocarpa* are more tolerant of the Northern Ireland climate than other poplars and most likely to be suited for general planting. Sites should have adequate drainage, and soil pH should exceed 4.5, and preferably be above 5.0. Until more information is available, sites with an elevation of more than 100m above sea level are not recommended for commercial poplar planting unless they are well sheltered.

Growth projections cannot be validated for Northern Ireland until spacing trials of *P. trichocarpa* clones and possibly hybrids of *P. trichocarpa* and *P. deltoides* are established on a wide range of sites. It is important that this precedes any large scale planting programme. However data from the Hollymount experiment are very promising.

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