Lodgepole pine — Silvicultural Alternatives

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BACKGROUND

Lodgepole pine is a very important constituent of the State forests in the Irish Republic. Three broad provenances are generally distinguished in the species planted here; coastal, Lulu Island and interior. These three provenances have quite different growth capacities and though all provenances have been planted since the twenties, various provenances have been fashionable in different periods, particularly interior in the late thirties while Lulu Island was generally planted in the fifties, though it must be remembered that coastal provenances were planted right through from the early twenties. Plantings from the mid sixties onwards have been almost completely coastal with the emphasis on south coastal provenances.

	Planting Year	Coastal	Lulu Island	Interior	Total
-	Pre 1923	15	and a manage	1	16
	1923-'27	66	_	4	70
	1928-'32	248	2	83	333
	1933-'37	913	5	110	1028
	1938-'42	992	167	765	1924
	1943-'47	1154	152	241	1547
	1948-'52	1772	884	1114	3770
	1953-'57	3101	5648	1037	9786
	Totals	8261	6858	3355	18474

Table 1. Area of lodgepole in hectares from 1968. Inventory, by age, class and provenance in pure and mixed stands.

GROWING SPACE IN CONIFEROUS CROPS

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SYMPOSIUM

U. C. D., BELFIELD, DUBLIN,4.

Signed: JIM DILLON

December, 1980

Planting	%	P/Year	%	P/Year	%
Pre 1923	100 <u></u> 100	1960	28.6	1970	23.9
1923-'27	2.7	1961	30.9	1971	20.6
1928-'32	6.7	1962	30.4	1972	21.0
1933-'37	10.7	1963	24.9	1973	21.6
1938-'42	16.4	1964	24.4	1974	23.5
1943-'47	20.2	1965	24.1	1975	28.7
1948-'52	23.3	1966	24.9	1976	32.6
1953-'57	34.7	1967	22.2	1977	34.7
1958	30.2	1968	24.3	1978	38.8
1959	26.4	1969	25.8		

Table 2. Lodgepole pine as a percentage of total forest area pre 1958 and as a percentage of Planting programme 1958-1978.

The weighted mean yield class for coastal lodgepole in the 1968 Inventory (1) was 113 hoppus feet per acre which is the equivalent of metric Yield Class 10 (2). This yield would be considered low by present day levels but many of these crops lacked fertilisation and ground preparation. The use of modern establishment techniques and more vigorous provenances during that last fifteen to twenty years has boosted average yield class considerably. This combined with the increasing usage of the species (see table 2) means that large areas are now in, or approaching thinning stage.

Lodgepole pine is confined to the poorer site types and these in turn are generally the more inaccessable, being often raised bogs or blanket peats. This means that roading is expensive and thus the cost of extraction of thinnings high. In the present climate of curtailed markets, the sale of such thinnings standing is difficult, particularly when more than sufficient spruce is available to satisfy demands for first and second thinnings. Under these circumstances other options should be considered.

SILVICULTURAL ALTERNATIVES

It is patent that various silvicultural alternatives exist but which one and what regime could be construed as the best option. It is difficult to forecast future timber demands but the following criteria could be acceptable guidelines.

- (I) Optimum saw log volume per hectare.
- (II) Shortest possible rotation.
- (III) Clean, knot free boles.
- (IV) Best financial return.

Bearing the above in mind but particularly accepting item IV for comparative purposes, a plantation of lodgepole in Lough Ennel Forest, Knockaville property, was studied. The following will give some idea of the plantation.

Site Type:	Raised midland bog, deep peat with full cover of
1.000	Calluna vulgaris.
Ground Prep.:	Ploughed prior to planting, ribbons about 2.0m apart with adequate network of drains.
Planting:	Carried out in 1970 with pure lodgepole pine at spacing of 2.00 x 1.5m approximately.
Area:	100 hectares of which 30 are the subject of this investigation.
Yield Class:	The estimated yield class at 9 years of age was 18.

An economic analysis was carried out on the following silvicultural regimes, which will be referred to as options.

OPTION A

This would be normal silvicultural practice as envisaged in lodgepole pine yield tables i.e. regular thinning from 18 years at 5 year intervals with clear felling at 50 years. Additionally, 400 stems per ha would be high pruned to 6m as in next option.

OPTION B

A respacement to 800 stems per ha at nine years of age is envisaged here. All stems would be high pruned to 6m in three stages as set out below.

Age	Height	Pruned height
	m	m
9	4	2
14	8	4
17	11	6

The crop would be clear felled at 35 years.

OPTION C

This is a no thinning regime with three possible rotations: C(I) - 30 years; C(II) - 40 years; C(III) - 50 years.

For the purpose of the economic comparison all costs to 8 years were disregarded and only costs from 9 years (1979) onwards were applied to the various alternatives. These costs can be found in the appendix. Most costs are standard values or based on actual work carried out at Lough Ennel Forest.

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ECONOMIC ANALYSIS

The volume and size classes used in the projections were taken from the standard yield tables where possible, otherwise figures are taken from tables developed by Crop Structure Section, Research Branch, Forest and Wildlife Service, Bray, using early results from their experiments, (see acknowledgements). Such projections may have a high error factor, but as conservative estimates of diameter development were used, we do end up with guidelines for management decisions, where none existed heretofore. Price assumed and size category assortments used, can be found in appendix. All costs and revenues are at 1979 levels. It is assumed that costs and revenues will equally keep pace with inflation so valid comparisons can be made.

RESULTS

Interest		Option			
Rate %	А	В	C (I)	C(II)	C(III)
2	7263	6152	3124	5812	7330
4	3500	3607	2070	3169	3286
6	1738	2101	1380	1744	1489
8	891	1205	926	968	679
10	472	667	625	540	309
Rotation Age	50	35	30	40	50

Table 3. Net Discounted Revenue (NDR) in £ per ha for one rotation.

Table 4. Order of Options from Table 3 figures.

Interest			Option			
Rate %	А	В	C (I)	C (II)	C (III)	
2	2	3	5	4	1	
4	2	1	5	4	3	
6	3	1	5	2	5	
8	4	1	3	2	5	
10	4	1	2	3	5	

The use of different rotation ages makes the selection of the most profitable options difficult, particularly if one wishes to apply the results generally. One method of correcting each option for the various clear felling ages is to discount an infinite number of rotations in each category back to the present. The establishment costs (not included in tables 3 & 4) have to be alotted in such an exercise and for this standard costs were used for the various operations in deep peat sites.

Interest			Option		
Rate %	А	В	C (I)	C (II)	C (III)
2	10999	11181	8676	10367	11066
4	4151	4778	3495	4132	3936
6	1770	2178	1483	1801	1521
8	881	1172	878	946	669
10	462	627	561	515	300

Table 5. NDR value for infinite number of rotations.

Interest	circuit ad		Option		
Rate %	А	В	C (I)	C (II)	C (III)
2	3	1	5	4	2
4	2	1	5	3	4
6	3	1	5	2	4
8	3	1	4	2	5
10	4	1	2	3	5

Table 6. Order of Options from Table 5 figures.

DISCUSSION

Table 4 shows that Option B is the best option for all interest rates except 2% while in Table 6 this option is consistently the best. The financially most rewarding regime is not always seen as of overriding concern in forest management decisions. Fortunately Option B scores well under the criteria mentioned earlier under "silvicultural alternatives": 79% of the timber is estimated to be in the large sawlog category, it is the second shortest rotation and the pruning regime outlined should give 6m of clean timber.

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The carrying out of this regime at Knockaville, Lough Ennel Forest did not pose any particular problems (Fig. 1). The selection of the trees to be felled was left to a workman who was told to work along each line, picking the best tree in a group of three trees and fell the other two. If he is unable to find a good tree within a group of three he can occasionally extend the group to four or five. Where the stocking is about 2,500 stems per hectare this system gives a respacement to around 800 stems evenly distributed. The cost of this operation was 22 smh (standard man hours) per hectare or £58 at 1979 prices. Low pruning to two metres generally involves cutting about 5 whorls, which in the south coastal provenance we were dealing with meant branch diameters of 1 to 5 cm.

Both chainsaws and pruning saw methods were used the costs being 13 standard man hours per ha $(\pounds 34)$ and 35 smh $(\pounds 93)$ respectively. The chainsaw method requires both skill and dexterity and a lightweight saw is essential to avoid worker fatigue. The ground conditions were difficult due to the combination of furrows, ribbons and 1600 felled trees per hectare. The answer may well be



Fig. 1 Respaced 10 year old Lodgepole pine (Coastal) at Knockaville, Lough Owel Forest.

a shears such as the New Zealanders use. The costs of first and second lift in the high pruning regime advocated are in the appendix, together with roading, maintenance and other expenses envisaged.

The general system envisaged here is not disimilar from that advocated and practised by foresters in New Zealand for radiata pine,³ though it must be remembered that the growth rates in New Zealand for radiata are far higher than anything possible for lodgepole here. There are also permutations in the system advocated such as taking a late thinning at say 30 or 33 years and having a longer rotation, thus producing a larger diameter log.

Windblow has not been mentioned and no experience is yet available of the effects of high winds on lodgepole in raised bogs. However it is reasonable to speculate that a system of respacement taken at a height of four metres must allow for a firmer root plate. Moore⁴ in his system of Oceanic forestry applied to Sitka spruce postulates, and rightly so, that a system of respacing at an early age must improve stability.

The question of disease must arise, since quite a quantity of debris from the trees felled is left lying on the ground and doubts as to the hygenic status of green pruning may be present in some minds. A thinning to waste in lodgepole (planted 1963) carried out in Castlelost property in Lough Ennel forest in 1976 was checked by Research Branch, Bray in 1979 and found to have no pathogenic problems except *Stereum sanguinolentum* in some lop and top and *Fomes annosus* in some stumps.⁵ These stumps had not been treated at the time of felling, and it is accepted that stump treatment with urea should be part of the respacement programme.

Green pruning experiments carried out by Gallagher⁶ have not shown ny significant disease resulting from the practice and from personal observation lodgepole pruning wounds have calloused quickly. In fact the main problem would be an epidemic of the pine shoot moth (*Rhyacionia buoliana*) after respacements, since with no thinnings one has no chance to dispose of damaged trees.

CONCLUSION

It is not possible to know the future but present evidence, combined with poor markets for thinnings and the inhospitable nature of deep peat as a medium to extract over, would merit serious thought to be given to the respacements and subsequent pruning of lodgepole pine crops as outlined in this paper.

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APPENDIX

The table below shows costs used. The figures are at 1979 levels and show rate per hectare.

Operation	Standard Man Hours	Cost
	Man Hours	III a
Mark Thinnings	10	26.50
Mark Final Crop	12	31.80
Prune to 3m (400 stems/ha)	15	39.75
Prune 3 to 6m (400 stems/ha)	38	100.70
Major Road Repairs	9	23.85
Gravel 25 M3 at £2		50.00
Respace to 800 stems/ha	22	58.30
Prune to 2m (chainsaw) 800 stems	13	34.45
Prune 2 to 4m (800 stems/ha)	34	90.10
Prune 4 to 6m (800 stems/ha)	60	159.00
Mark Final Crop (in option C)	24	63.60
Annual Maintenance/ha	-	8.00

The different costs for the various Options were applied against the year in which they deemed to occur. Some costs were repetitive such as thinning in Option A and of course each option had major road repairs prior to harvesting.