# The case for Insignis Pine in Irish Forestry

By GERALD SCULLY

WHILE nobody will deny that tree planting must be a permanent function and duty of the State in most countries to-day, there is, nevertheless, an increasingly evident tendency to regard forestry, particularly on the better sites, as another form of investment enterprise taking its place amongst so many others in their contending claims upon the capital available for national development. It is essentially a question of reconciling these contending claims in the best national interest and one of the ways which the forestry technician can best serve this interest is by the close study of comparative financial returns from the planting of the various species. One species whose potential value does not yet seem to be fully appreciated in this country is the insignis pine (*Pinus radiata*).

*Natural Habitat of Insignis Pine.*

The natural habitat of insignis pine is restricted to a small area on the coast of California. It is interesting and, indeed, important that a tree of such limited natural distribution should be so successful in the commercial afforestation of New Zealand, South Africa and Australia. The chief centres of its distribution in California are Monterey, Cambria and Swanton. The region is one of little climatic variation, characterised by mild winters and slight frost, the minmum tiemperature being 20°-24° Fahrenheit throughout.

The following is the mean monthly temperature at Monterey extracted from Mr. A. D. Lindsay's Report[1]

| | | | | | | |
|---|---|---|---|---|---|---|
| January | 50.2 | May | 58.3 | September | 61.5 | |
| February | 51.2 | June | 60.8 | October | 58.2 | AVERAGE |
| March | 53.9 | July | 60.0 | November | 54.3 | 56.4 |
| April | 55.8 | August | 61.9 | December | 51.7 | |

The rainfall at the same station is 16.71 ins. annually, the heaviest incidence occurring between November and April.

A wide variation in geological and soil conditions is found within the region of its natural habitat. At Swanton the rock formation is shale with marine sandstone of miocene age; at Monterey granite and further east sandstone layers, whilst at Cambria sandstone and limestone occur. The best stands of insignis pine are found on soils derived from transported material rather than from parent rock. It rarely grows on soils with underlying rock too near the surface and soils of 1 foot—2 feet are its usual rooting medium. In its natural habitat insignis pine is of insignificant economic importance. It is preserved for scenic rather than for economic reasons. Lindsay says that it is a prolific annual seeder, with a high percentage germination. It also regenerates freely.[1]

*Growth.*

There is little accurate information regarding its growth in California as practically no research or annual assessments have been made there. Doctor C. S. Larsen has found a wide variation within the species with trees of 130 feet high right down to dwarf bush-shaped specimens, some of which were dead or dying. He attributes this wide differentiation to genetical factors rather than to soil or climatic variations in view of the relatively limited extent of the area.(2)

In an assessment carried out in the Cambria area Mr. L. T. Larsen found insignis pine 20 feet high with 2.5 inch D.B.H. at 5 years; 64 feet high with 12 inch D.B.H. at 20 years and 82 feet high with 18.1 inch D.B.H. at 40 years.(1)

## Insignis Pine in New Zealand

Insignis pine was introduced into New Zealand by the settlers in the sixties of the last century. By 1920 its possibilities as a tree capable of making a major contribution to solving the nation's timber needs were realised. During the period of the "great afforestation boom" from 1923 to 1936 80 per cent. of exotic conifers were planted, a happy situation created by the healthy co-operation of private and State forestry. The statistics indicating the extent and the nature of the ownership of the exotic forest area in New Zealand in 1947 and the imposing contribution of insignis pine to the totals in each, make interesting reading. In that year insignis pine accounted for 48 per cent. of the 447,500 acres of exotic forest under State ownership, 91 per cent. of the 313,000 acres held by commercial undertakings and 85 per cent. of the 100,000 acres owned by farmers and private landowners.(3) The percentage of this species in private lands is a tribute to its capital attractiveness. The total extent of insignis pine plantings in New Zealand, to-day exceeding 608,000 acres, is the most eloquent possible testimony of the importance of the species in the forest development pattern of that young country.

In New Zealand it is suited to wide variety of mineral soils provided the drainage is good. The underlying rock is mainly pumice. With this tree satisfactory growth can be had up to 2,000 feet elevation, while it does well in the rainfall range of 30 ins.-80 ins.

*Silviculture and Volume.*

In New Zealand the seed of insignis pine is sown in the spring. The seedlings grow vigorously and their roots require frequent undercutting in order to avoid the necessity for lining out. Planting out in the forest takes place after the plants have spent one or two years in the seed bed. The yields and growth are remarkable and it is regarded by New Zealand foresters as the world's fastest-growing conifer. At 40 years it yields 10,000 cubic feet of saw-logs per acre and intermediate yields of 5,000 cubic feet of pulp wood per acre are quite usual.

There is a perceptible falling off in growth from 35 years which is apparent from yield figures given below; this indicates the desirability of early harvesting of the crop. In California the species has a life expectancy of 80-90 years.

*Table I.*

*YIELD TABLE GOLDEN DOWNS FOREST (NEAR NELSON)*[4]

*Data collected from 25 plots of unthinned insignis pine*

| Age | Stems | Height | Mean D.B.H. | Volume cu.feet to 4 in. top diam. |
|---|---|---|---|---|
| 5 | 1,200 | 18 | 2.1 | — |
| 10 | 1,000 | 36 | 4.9 | 890 |
| 15 | 600 | 57 | 8.0 | 3,420 |
| 20 | 370 | 79 | 11.0 | 5,940 |
| 25 | 270 | 99 | 13.5 | 8,360 |
| 30 | 220 | 111 | 15.4 | 10,100 |
| 35 | 192 | 118 | 17.0 | 11,400 |
| 40 | 173 | 123 | 18.3 | 12,400 |
| 45 | 157 | 127 | 19.5 | 13,200 |
| 50 | 143 | 130 | 20.7 | 13,800 |

The New Zealand forest service has carried out research on quite an extensive scale in the field of timber development and utilization.

The following extract from the published results of this research serves to indicate the principal strength qualities of exotic New Zealand timbers on a comparative basis : [5]

*EXOTIC SPECIES*

| NAME | Condition at Test | Weight per cub. foot in lbs. | Modulus of rupture in bending lbs. per sq. inch | Maximum crushing strength parallel to grain lbs. per sq. inch | Modulus of elasticity in bending 1,000 lbs. per sq. inch | Shear strength parallel to grain lbs. per sq. inch |
|---|---|---|---|---|---|---|
| Pseudotsuga | Green | 36 | 6,300 | 2,800 | 1,100 | 830 |
| taxifolia | Air Dry | 27 | 9,050 | 4,900 | 1,260 | 1,220 |
| (Mackenzie County) | | | | | | |
| Pinus radiata | Green | 58 | 5,900 | 2,600 | 1,060 | 870 |
| (Rotorua | Air Dry | 28 | 11,200 | 5,600 | 1,340 | 1,550 |
| County) | | | | | | |
| Cupressus | Green | 50 | 8,000 | 3,800 | 970 | 1,010 |
| macrocarpa | Air Dry | 31 | 10,900 | 5,900 | 1,180 | 1,620 |
| (Tuapeka County) | | | | | | |
| Larix decidua | Green | 41 | 7,500 | 3,200 | 1,320 | 830 |
| (Roturua | Air Dry | 35 | 13,500 | 7,100 | 1,740 | 2,060 |
| County) | | | | | | |

The test samples were in the form of small, clean specimens and the air dry values were adjusted to 12 per cent. moisture content. A study of the Table indicates that the air dry condition of insignis pine compares most favourably with the other species as far as the listed properties are concerned although it must be conceded that the strength qualities of larch are conspicuously greater.

Unfortunately, there is little information in the above as regards the radial density gradient theory : it is of importance to know the radial position in the tree, the height of the tree at which the samples were taken, the age of the wood, the number of rings per inch of the sample and the proportion of spring in relation to summer wood.

Authoritative opinion considers the bulk of the sawn timber of insignis pine sufficiently good to justify confidence in its suitability for a wide range of constructional uses, provided that it is graded properly and adequately protected from sapstain.(5)

A study of annual reports of the Forestry Service of New Zealand since 1945 gives an indication of the increasing importance of this tree in the economy and its effects upon the balance of payments. In 1955, for instance, New Zealand exported approximately $1\frac{1}{4}$ million pounds worth of sawn insignis pine timber amounting to 38 million board feet (12″ × 12″ × 1″). For 1956 it was intended to expand exports of this material to reach 50 million board feet. New Zealand's domestic consumption of exotic softwoods in the year 1954 could not have been imported at less than 15 million pounds.(6) The fact that the great bulk of this material was drawn from insignis pine stands is another graphic pointer to the rôle which this species plays in the country's financial well-being. The above facts and figures reflect the importance of this tree in New Zealand's contemporary economy and endorse the wisdom of those responsible for its selection in planting projects.

## Performance of Insignis Pine in Ireland

*Curracloe Forest, County Wexford.*

The earliest recorded information under Irish conditions known to the writer is to be found in an article by Mr. J. J. Deasy in "Irish Forestry" in 1946. This article dealt with the afforestation of sand dunes on the Wexford coastline. It was recorded by Mr. Deasy as the second safest species to plant there following maritime pine.

*Sliabh na mBan Forest, County Tipperary.*

In 1948 in the same journal Mr. N. O'Muirgheasa described its performance under inland conditions at Sliabh na mBan Forest, County Tipperary.(8) Two sample plots measured in this forest in May 1957 provide interesting illustration of the behaviour of this species under Irish conditions. An arithmetic average of two plots, each of which

were one-twentieth of an acre, were taken. The plots had to be small because the belt carrying the insignis was narrow and irregular in shape.[8] The border line of trees was omitted from the reckoning in order not to inflate the volume per acre. The diversity in quality noted earlier by Mr. O'Muirgheasa is now even more pronounced and the Officer-in-Charge, Mr. H. McGuire, pointed out some stunted trees of poor form which may be due to genetical factors. Some well-shaped boles were, however, in sufficient numbers to make a final crop. Gaps were frequent resulting from transplanting failures which are usual with the species. Natural regeneration in the form of 3 inch seedlings was also a feature of the plots measured. Some data concerning growth are as follows :—

| Name | Age years | Range of B.H.Q.G. ins. | Mean B.H.Q.G. ins. | Height to 3 ins. Drain feet | Total Height feet | Overbark Vol. to 3 ins. dlam. per acre hoppus feet | Number of stems per acre |
|---|---|---|---|---|---|---|---|
| (a) Insignis pine | 20 | 3-9½ | 7¼ | 33 | 44 | 3,630 | 440 |
| (b) Scots pine | 20 | 2-4¾ | 3¼ | 14 | 26 | 925 | 760 |
| (a) European larch | 20 | 2¼-4¼ | 2¾ | 17 | 29 | 925 | 160 |

Estimated Volume removed in thinnings to date 300 hoppus feet.

(b) being mixture of scots pine and european larch.

The plots in which the trees mentioned at (b) above were measured because of proximity to (a). The quality of the pine and larch in the sample plot was, if anything, better than the average for those species on this site. Here and there the furze was cut as the poor growth of both species failed to overcome the competition from the former.

The success of insignis pine in Sliabh na mBan Forest is important as it indicates its suitability for inland sites as well as coastal regions.

*Delgany Forest, County Wicklow.*

Compartments 3 and 4, Belleview Property, 500 feet—600 feet elevation with northern aspect: this area contains a narrow belt of insignis pine one chain wide sheltering scots and corsican pine. Measurements of sample plots in May 1957 yielded the data set out below. Again the marginal row of trees was omitted in order to eliminate the possibility of inflation of the volume per acre.

The underlying rock of this property is of silurian formation. There is a top soil of 9ins. over a porous stony subsoil of considerable depth. The existing vegetation on the margin of this belt is mainly *Ulex europaeus* and *Holcus lanatus.* The cutting of *Ulex europaeus* has resulted in the growth of *Pteridium aquilinum, Agropyrum repens* and *Rubus fruticosus.*

| Species | Age | Range of B.H.Q.G. ins. | Mean B.H.Q.G. ins. | Height to 3 ins. top diam. feet | Total Height feet | Hoppus feet per acre | Number of stems per acre |
|---|---|---|---|---|---|---|---|
| (a) insignis pine | 24 | 5-13 | 9 | 37 | 46 | 4,215 | 360 |
| (b) corsican pine | 24 | 2-6¼ | 4½ | 19 | 28 | 1,413 | 510 |
| (b) scots pine | 24 | 2½-6½ | | | | | 250 |

Mr. Doyle, Officer-in-Charge, estimated the volume removed to date in thinnings as 500 hoppus feet.

(a) In the entire belt the largest tree measured was 15½ ins. B.H.Q.G.

It was observed from a stem analysis of one tree in the mean B.A. group that the rate of height growth was slow in the early years and that it gradually increased till it reached a maximum of 3 feet in its 7th and 11th years and fell to 1¼ feet in the last few years.

(b) The largest tree in the whole area was a corscican pine of 7½ ins. B.H.Q.G.

In the plot the ratio of corsican to scots pine was 2 : 1 approximately.

*Avondale Forestry Station, Co. Wicklow.*

The 1½ acre insignis pine plot here was planted between 1906 anl 1911 (beating was necessary) in a light loam on a ridge of high ground at 600 feet elevation. The underlying rock is silurian shale with intrusions of diorite and felspathic ash. The plot was planted with a 50/50 mixture of insignis pine and european larch. There was difficulty in establishing the pine owing to transplanting failures and it is recorded that some were killed by winter frost when up to 12 ins. high.

In 1949 Mr. J. J. Deasy, then Officer-in-Charge, assessed the plot and found that there were 172 stems of insignis pine with an average B.H.Q.G. over-bark of 17 ins. and a volume of 14,939 hoppus feet. In addition there were 184 stems of european larch with an average B.H.Q.G. over-bark of 8½ ins. and a volume of 2,645 hoppus feet. This worked out at 9,626 hoppus feet of insignis pine and 1,763 hoppus feet of european larch per acre. The present Officer-in-Charge, Mr. M. O'Donovan, states that satisfactory reports have been received regarding the general quality of the insignis pine timber sold from the plot, but that it did not plane well. Natural regeneration of this species seems possible in this country as here some natural seedlings 12 ins. high can be seen competing with the meadow grasses.

This plot can hardly be regarded as representative of possible development elsewhere in Ireland as it was an experimental plot on ground which was moderately good agricultural land, the use of which, for afforestation purposes, is not at present generally advocated or encouraged. Crops of the species should do extremely well and provide

an adequate financial yield on sites similar to those at Delgany and Sliabh na mBan.

In the West of Ireland some fine specimens of insignis pine were observed on limestone in Nutwood Property of Gort Forest. Their performance together with that of the referred to plots confirm the belief that this tree can be successfully grown over a wide range of soil types in Ireland provided the land is well-drained and affords good anchorage.

### *Climatological Data*

It is intended as far as it is possible with the limited data available to compare climatological factors in New Zealand with those in Ireland. Golden Downs has been selected as it is the centre of a large insignis pine area and it is also mentioned in Table I.

*Golden Downs (Nelson) Temperature F*

| | 1951 | 1952 | 1953 | 1954 |
|---|---|---|---|---|
| Mean Maximum | — | 60.3 | 60.2 | 61.8 |
| Mean Minimum | 39.4 | 40.7 | 40.7 | 40.8 |
| Extreme Maximum | 79.0 | 82.7 | 78.5 | 92.5 |
| Extreme Minimum | 19.0 | 17.6 | 19.5 | 20.0 |
| Number of days frost | 116 | | 90 | 113 |

The average rainfall over the above period was 52.9 ins. Over the whole area of insignis pine plantations the number of snow falls ranged from 0 to 10 in 1953. In the 1956 annual report there is mention that the drought of 1955 caused growth to be retarded to ⅓ of the level of normal years. Despite the large number of days of ground frost there is no published data on damage.(6)

*Ireland.*

At Carrick-on-Suir which is 10 miles from Sliabh na mBan Forest the average temperatures over 21 years were as follows: *Maximum Temperature 54.9 and Minimum Temperature 42.4. An extreme minimum reading of 20° for January and February 1957 was recorded. In January 1940 16 degrees was recorded. From 1942 to 1950 the average number of days of frost was 64. The range being from 44 days to 79 days. The minimum temperature is the more important for the Irish forester and it is recorded that plants up to 18 ins. have been killed by ground frost.

* Data supplied by the Dept. of Industry and Commerce, Republic of Ireland.

*Establishment Problems under Irish Conditions.*

Insignis pine which is a rapid producer of valuable timber suffers, however, from a serious disability and that is, as already implied, the difficulty in transplanting it successfully. Foresters in Ireland and Great Britain are acutely conscious of this establishment problem and many

suggestions have been put forward from time to time to overcome this disadvantage. In South Africa it is customary to plant this species in times of heavy rainfall. In the light of this practice the monthly precipitation figures for this country would appear to suggest planting during the periods of highest rainfall in October, December and January as a means of reducing the high mortality rate. It is recommended that the period between lifting in the nursery and planting out should be as short as possible—certainly not more than four or five days. If this species is to come into favour it is essential that this difficulty should first be overcome. This problem is not an easy one and the solving of it is a challenge. Tests along the following lines might yield some helpful results :—

(i) Frequent undercutting of the roots in the seed beds and direct planting in pits specially prepared in advance.

(ii) Detailed costing analysis of (i) as against the "root balled" method of planting.

(iii) A cost investigation of planting the species in soil-containers of the cheapest possible construction.

(iv) Grafting from selected trees; this method gave excellent results in New Zealand where 12½ years old trees produced five times as much wood as those derived from seeds collected at random.[2]

As regards (iii) above, Mr. W. Seymour, in his observations of the afforestation of the Schmittenhöhe in Austria noted the use of wooden tubular containers for encasing soil and roots. Should the cost of wooden containers prove too high some substitute such as plastic or tin tubing might be found equally effective for the purpose.

*Land Use.*

To-day the price of labour and capital is high, therefore, landowners must wisely apply these factors of production to their holdings in order to get maximum return from the soil. It is necessary for landowners to utilize to the full the various soil types and the resultant profits are the measure of the skill of this soil utilization.

Those in charge must keep in mind the supreme importance of the length of the rotation and of costings. The price which the planter will get for the final product will determine his profits after he has covered interest charges, and establishment, administrative and marketing costs. He may decide to grow a species which produces second-quality class timber with a large volume output per acre or he may decide to grow one which produces high-quality class timber having a low output per acre. The longer the rotation the more expensive the product will be. To pass on the higher price to the customer may not be quite so easy. In the world of commerce the consumer is usually master as he is the

payer. When the price of a commodity goes too high the consumer will look for a substitute. Constructional wood is being replaced by other materials mainly as a result of the continuous rise in the price of sawn timber. We must keep the price of wood down and one way of doing this is by using, if possible, species which are capable of reaching an economically utilizable size in the shortest possible time. This can be done by planting a tree such as insignis pine for constructional uses which will give saw-log timber in 40-45 years and industrial wood in 20 years. Scots pine, corsican pine and european larch which are normally planted on sites suitable for insignis pine cannot do this. Hiley proves with economic detail that in growing douglas Quality Class II to 12¼ ins. B.H.Q.G. and scots pine Quality Class III to 8½ ins. B.H.Q.G. it will cost 12.2d. per hoppus foot to grow the former and 72d. to grow the latter.(10) Even from the scanty data concerning insignis pine plots measured it is clear that we have here a species with volume production capacity equal to Quality Class II of douglas. Insignis pine has, however, the great advantage of being capable of withstanding considerably more exposure than douglas. Comparisons of the relative properties of the wood of insignis pine grown in Ireland with other conifers would be of great value.

Irish climatic conditions give advantages in tree growth in certain species over most if not all European countries. So far as this production of constructional timber is concerned it is obvious that what is required is specialization in these species and a scientific regulation of their growth in the production of timber of 14 ins. B.H.Q.G. in the minimum time.

Mr. G. R. Jacob stresses the necessity for the growing of timber to certain range sizes of less than 14 ins. B.H.Q.G. He quotes Scandanavian practice where the utilization of small diameter timber has been successfully and profitably practised.(11) If the planter wishes to obtain reasonable profits and compete keenly in the world market a short rotation and the production of timber of not more than 14 ins. B.H.Q.G. should be his aim.

*Pure Planting of Insignis Pine.*

Pure planting of conifers give advantages of economy in establishment and simplification of management. It is true that pure conifers in large blocks are not as beautiful as mixed woods, the former being dull and unattractive. At the same time the Black Forest in Germany owes its name to the dark colour of a few species and yet it attracts tourists.

Because of the economic advantages it is suggested that insignis pine should be planted pure. It could be a dual purpose tree in Ireland —both profitable and beautiful. In California it is retained for its beauty. It is called insignis because of its remarkable beauty in California. In Ireland belts of hardwoods could be planted through the

pure blocks for aesthetic and silvicultural reasons, providing attraction for tourists and sportsmen.

It has been found that pure crops of pine cause degradation of the soil. The most recent view from Mr. P. J. Rennie of the Research Institute of Oxford is that in forestry, like agriculture, the removal of timber upsets the chemical composition of the soil. It has been stated that the calcium, potassium and phosphorous removed by way of timber should be made good from artificial sources.(12) Insignis pine because of its yield potential is a species that will enable the grower to restore the soil fertility and at the same time give him a reasonable margin of profit.

The available information as regards the performance of insignis pine here is scanty as the plots are too small, most of them having been planted as wind-screens. The trees have not been grown in close formation and therefore, rough timber has been produced. If larger areas of fully stocked and suitably thinned plantations could be achieved the position would be different.

Planting at 6 feet × 6 feet is recommended as well as pruning of 160 stems per acre to a height of 20 feet—30 feet when diameters are 4 ins.—5 ins. Green pruning is recommeded as insignis pine was one of the few species which the late Mr. M. O'Beirne recommended to green-prune. Controlled thinning to give even ring widths of 6 rings per inch and thinning to the finest shaped boles is suggested for the production of saw-log timber and timber suitable for veneer work.

Plantations for the production of timber for industrial uses such as pulp could be planted at 9 feet by 9 feet and worked on a 20—25 year rotation. Pruning and thinning in such a rotation would not be necessary.

It is felt that the time has now come when the planter must specialize with fewer species in order to capture some of the commercial advantages which accrue from specialization and it is the writer's opinion that insignis pine should figure prominently among the species selected.

In conclusion it is well to reflect again on the example of the New Zealanders and on the courage and wisdom with which they faced the crucial decisions that always confront a young nation forging a new economy. There sawmills, wood preservative yards, drying plants, pulp and paper factories, veneer and plywood installations, all play their part in creating an economic climate of progress and prosperity for a people with confidence in their country's grand possibilities and the initiative to bring these possibilities to the goal of practical realisation.

The writer wishes to acknowledge his indebtedness to the Secretary, New Zealand House, London, for much of the information contained

in this article and also to the Forestry Division of the Department of Lands, Dublin for permission to measure some of their stands.

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(2) C. S. Larsen — Genetics in Silviculture—1956. (Oliver and Boyd Limited).

(3) F. W. Foster — Exotic Forests of New Zealand—1947. *State Forest Service New Zealand.*

(4) E. R. Lewis — Forest Research Notes—1954. *New Zealand Forest Service.*

(5) *New Zealand Official Year Book 1956.*

(6) Annual Reports of the Director of Forestry 1945-1956 *New Zealand Forest Service.*

(7) J. J. Deasy — *"Irish Forestry", Vol. III, No. 1, June, 1946.*

(8) N. O'Muirgheasa — *"Irish Forestry", Vol. V, Nos. 1 and 2. Winter 1948.*

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(11) G. R. Jacob — *Timber Trades Journal. February and April, 1954.*

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