

The Role of Mixed Woods in Irish Silviculture

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Foresters the world over are recognising more and more the value of a proper mixture as a factor in the successful establishment and management of tree crops. While the practice of raising mixed crops is very long established in this country and while most of the timber felled here in recent times has come from mixed stands, there has been a tendency to depart from this old and well-tried system and to lay down extensive areas under pure spruce or pine. This practice is, no doubt, dictated by financial considerations and the exigencies of large scale afforestation, but if we are to judge by the consequences of similar practices abroad there is a danger that serious losses or disappointment may be experienced.

In Saxony the craze for financial yields and short pulp wood rotations led to the extensive use of Norway Spruce on soils outside the natural range of the species. This practice was carried out successfully for two rotations owing to the fact that the extension of spruce planting was usually at the expense of beech, silver fir or pine on woodland soils. Two crops were sufficient to produce serious soil deterioration and this, accompanied by epidemics of insect and fungoid pests, caused complete failure in the third rotation. Similar experiences in other countries have led to a great reversion in many parts of Europe to a more natural form of silviculture. There has been an ever-growing interest in the rôle of "good companion" and pioneer species in the maintenance of healthy conditions in the forest.

Hayes On Mixed Woods

The value of mixtures has long been recognised here as can be seen by the composition of the greater proportion of our mature plantations. On this aspect of afforestation in 1822 Hayes, of Avondale, in his "Practical treatise on the planting and the management of Woods and Coppices," writes: "Providence has wisely scattered the food of each plant over the surface of the earth, so that many trees, of different species, will grow well in an acre of ground, where the same number of one kind would actually starve for want of nourishment; and we have only to view a grove of the last age, consisting of one species of trees, to be convinced of the inferiority

of each tree which composes it, to one of the same age growing amongst plants of different species though equally close and numerous." Dealing with the planting of scrub land he writes: "Experience has proved that where hazel and whitethorn grow with vigour almost every species of tree may be planted to advantage; it will only be found necessary to prevent the branches of the shrubs from over-topping or interfering with the young shoots of the plantation"; or further: "in the spaces which they (the planted trees) may fill amongst the shrubs and underwood they will certainly succeed and make good trees." Since this was written forest practice has seen the adoption of large scale afforestation of pure conifers on bare ground and the practice of clear felling and entirely removing all shrubs and woody growths before planting. We are now, after more than 100 years, back to Hayes's way of thinking again. For example, with regard to the planting of hardwoods such as oak, ash, etc., he recommends planting "at about twenty feet as under . . . the plantation should then be thickened up with any other sort of trees." This surely reads like some recent instruction to foresters urging them to adopt this "new" way of establishing hardwoods in a matrix of conifers.

In making these remarks I do not wish to convey that the value of mixtures was entirely overlooked at any period here, but the extensive afforesting of bare land made it impossible to follow rules which apply to establishing under a shelterwood. The introduction of exotic conifers, whose silvicultural requirement or comparative growth rates were to a large extent unknown, made it a difficult matter to select suitable mixtures. It is to the credit of the older generation of foresters that in early experimental plantings of exotics here, mixtures were the rule rather than the exception. However, experiences with such mixtures were not always too happy.

Mixtures at Avondale

Mr. Forbes, in laying down the experimental plots at Avondale gave considerable attention to mixtures and, as a rule, pure crops of all important species were planted side by side with the same species in mixture, with a view to noting their development under both conditions. In view of the importance of this particular aspect of afforestation work and to illustrate the main difficulties which arise in the handling of mixed stands, the experiences with some of these experimental mixtures in the Avondale experimental plots might be considered.

Mixtures of Hardwoods

The most favourable mixture from a silvicultural point of view is a mixture of tolerant or shade bearing species with intolerant or light demanding species. Several such mixtures were initiated at Avondale, of which the following are the most important:

(a) Mixtures of light demander with shade bearer . . . sessile oak and beech.

A successful mixture of oak and beech has much to recommend it. The oak being an intolerant species is incapable of keeping full canopy after the thicket stage is passed. The gradual opening of the canopy, after the pole stage has been reached, leads to a deterioration in surface conditions and also to the development of epicormic branches on the boles of the trees. A mixture of beech helps to keep the forest floor free from grass and weeds and also, by its relatively dense shade, prevents the development of "water shoots" in the oak. It allows more freedom in thinning. The crowns of the better boled oak can be freed and girth increment encouraged without fear of deterioration in quality of bole or ground conditions.

The development of this mixture at Avondale (Plot 2, Section IV) leaves much to be desired. The beech, which proved a more vigorous grower in the early stages, out-topped the oak and suppressed it over most of the plot. This illustrates one of the most troublesome aspects of mixtures; the tendency for the tolerant species to outgrow the more valuable intolerant species.

A mixture of pedunculate oak and beech suffered the same fate (Plot 9, Section IV).

It might be considered that hornbeam and oak would be a more suitable mixture, but here again (Plot 6, Section IV) we find the tolerant hornbeam outpacing and completely suppressing the oak before the crop was in its thirtieth year.

It appears, therefore, that intolerant hardwoods such as oak and ash should be planted some years in advance of the tolerant species. Oak and beech are usually grown as a two-storied mixture in Europe. The oak is initiated by sowing or close planting. A dense canopy is thus maintained on into the small pole stage. When the better shaped dominants begin to pull away from the general crop and show a clean length of bole of 30 feet or so, heavy thinning is commenced to allow the crowns of the dominants to build out so that rapid growth is maintained. Beech comes in naturally or is planted at this stage and develops readily under the light shade of the opening under canopy. The beech soon reaches the lower crown of the oak and helps to prevent the eruption of epicormic branches. When the crop is ready for felling both species are removed together, the beech selling as firewood and the oak as high-class veneer or furniture wood.

(b) Mixtures of intolerant or light demanding hardwoods.

It is a fundamental principle of silviculture that intolerant species are unsuitable to crown mixing. Such a mixture, oak and ash (Plot 1, Section IV) illustrates this nicely. The ash outgrew the oak, leaving it as a stunted understory. The ash itself is of very poor quality and owing to the low stocking of dominants, there are not sufficient good stems for selection for a final crop. The ground is a wilderness of briars and filth.

(c) Temporary Mixtures.

The rapid growth and high value of European larch, Japanese larch, Norway spruce in the early pole stage make it economically desirable to mix them with species which, though valuable as timber, yield worthless thinnings. Larch and Scots pine is a common mixture in Irish silviculture. Although this is a mixture of intolerant species and has little to recommend it silviculturally, it is approved on financial grounds wherever the soil conditions are sufficiently good to merit its trial. However, there are few instances of successful crops being raised with this mixture. On good ground the larch gets away and unless carefully watched will suppress the pine; on poor pine ground it fails to thrive and is suppressed by the pine. With careful watching, however, good crops can be raised, especially where, on moderately dry soils, over Silurian rocks with a proportion of *Erica cinerea* in the ground vegetation, the two species come away fairly evenly. The larch is able to suppress side branches on the pine and draw it up nicely, but the crop tends to develop into a mixture by groups as the ground varies to favour the larch or the pine.

There is no plot representative of this mixture at Avondale, but, as the soil is somewhat rich and loamy, it can be assumed that the larch would have proved too vigorous for the Scots pine. This has happened in the case of the Corsican pine, European larch mixture (Plot 2, Section VIII). The pines were all killed out before the crop was 30 years old.

Other mixtures coming into this category are oaks and larch, oaks and spruce, maples and larch. In the case of all these mixtures the larches and spruces, which were to play a temporary rôle, succeeded in suppressing the other species and forming pure crops in a relatively short time. It would have been much less expensive in each case to plant larch or spruce pure, so these mixtures, really unsound silviculturally have not proved themselves to be financially desirable either. It is not suggested that temporary mixtures may not be successfully managed and made to yield the results desired, but it does seem that mixture by individuals is seldom really successful and the beneficial results from mixtures might be more cheaply and easily obtained by other methods. Mixture by lines is just as difficult to control as mixing by single trees, but may be cheaper to plant and thin.

(d) Temporary Mixtures to reduce planting costs.

Crops of rare exotics and certain hardwoods are costly to establish if the full complement of plants is used all over the area. Considerable saving might result from the use of common, inexpensive species as fillers; these latter to help cover the ground and provide for the cleaning of the main crop trees. There are many examples of this type of mixture in Irish silviculture. In the Avondale plots this type of temporary mixture was adopted with all the expensive species. The results obtained have been variable. *Abies grandis* and *nobilis* planted 8' by 8' and fillers of *abies pectinata* used to give 4' by 4' planting rate over the ground resulted in early and complete elimination of the *pectinata*. The main crop species developed as if planted at 8' by 8'. The fillers used in this case were of little value in providing a temporary mixture and better results might have been more cheaply attained with 6' by 6' planting of the main crop.

Similar results were obtained with a mixture of *pinus insignis* and European larch, the latter being suppressed too early to have had any silvicultural significance. Larch as a filler suppressed *pinus strobus*. Japanese larch suppressed Norway spruce in a mixture in which the latter was to play the rôle of a filler; the larch, however, was planted close enough for normal stocking and a good, pure crop resulted.

(e) Mixtures to protect tender species against frost.

In view of the importance of frost as a site factor affecting the establishment of such tender species as Sitka spruce, silver fir, ash and beech, and the attempts being made to raise crops of these species by mixing with frost hardy nurses, it is interesting to find a fairly thorough account of the behaviour of such a mixture in Avondale. Japanese larch was mixed in 1905 with Sitka spruce in alternate rows with 4' spacing. The Sitka spruce suffered during the first five or six years after planting from spring frost and aphid damage and by 1914 the Japanese larch was dominating the spruce and suppressing it. In 1917 a careful inspection of this plot led to the conclusion that the Sitka spruce were past recovery, many of them being completely leaderless and resembling bushes rather than trees. The idea was favoured of growing a mixed crop of larch and spruce, side pruning or removing the former in places where the spruce was most promising and allowing the latter to die out in the least flourishing parts. The result of this thinning and pruning was so striking, however, that it gradually extended from year to year, the spruce recovering, as soon as light had been admitted, in the most remarkable manner. Numbers of trees which appeared to have lost all trace of leaders at one time began to form them about an inch in length. In the second year these dwarf leaders developed into 6" to 12" growths and in the third year after thinning a normal growth of

2' to 3' was being made. The volume of Japanese larch removed by 1925 was 3,345 cubic feet. The Sitka spruce had reached a volume of some 3,500 cubic feet by 1938.

If any conclusions can be drawn from this record it is: that the Japanese nurse might best have been established pure at 8' by 8' as an advance crop and thinning resorted to when the crop was 12 to 15 years old, when the Sitka spruce could have been introduced with equally good results.

The Japanese larch has many qualities of a good nurse being a rapid grower and easily and profitably disposed of in the pole stage. It, however, sheds a fairly heavy shade and only fairly tolerant species can be raised successfully under it. Sitka spruce seems to have many of the characteristics of a moderately tolerant species and might well be raised under an open pole crop of Japanese larch. Another lesson to be drawn from this plot is that the nurse species had little or no effect in mitigating frost damage until it formed canopy, but when the crop was thinned in the pole stage, the newly revived spruce suffered no longer from frost on a site where damaging spring frosts were a regular factor.

If one considers the value of mixtures as shown by the results cited above it would seem that their disadvantages far outweigh the advantages. In all cases in Avondale pure crops have been satisfactorily established at much cheaper rates and in very few cases have they spoiled for lack of attention. It appears then that on good soils little advantage and much waste results from even-aged mixtures by individuals or lines, and unless skilled and timely attention can be given, poor crops result.

The easiest and most natural form of even-aged mixture to establish is one composed of small pure groups. This method is especially suitable where an intolerant species, such as oak, is to be grown in a matrix with more vigorous trees such as spruce or larch. In recent years this method of mixing is coming more and more into vogue. Oak, ash, sycamore and other hardwoods are now usually initiated here in pure groups of closely planted trees, spaced 21' or so from centre to centre, and the remainder of the ground stocked with fillers such as Japanese larch, Norway spruce, beech, European larch, Lawson's cypress. Most of these mixed crops are still in the pre-thicket stage and while they are developing satisfactorily so far, it is too early to pronounce on the merits of this method of establishing mixed crops under Irish conditions.

So far, all the examples chosen refer to good sites for planting: that is, old woodland soils or good old pasture, well supplied with good humus and plant food, and well aerated. The reasons for choosing mixtures on such sites are purely financial and aim at early returns or cheap establishment. There are, however, large areas of degraded soils overlying the acidic Old Red Sandstone or granite rocks of our mountain ranges, where crop establishment is decidedly difficult. It is on such soils that mixtures are really of immense, and in some cases, of vital importance. Most of our commercial forest trees are exacting in their demands on site and will not thrive when planted pure on poor ground or under unfavourable climatic conditions. The value of nurse, or "pioneer" species in helping the establishment of exacting species has long been recognised. In Sweden, the birch is regarded with great reverence owing to its important rôle as a "pioneer" species on deforested land. I will always remember the fervour of a Swedish forester as he told of the wondrous "mothering" qualities of the birch. He pointed out an area where fire had destroyed a large section of spruce forest many years previously. Artificial regeneration was immediately resorted to, but

repeated plantings of spruce failed and the attempt was abandoned in despair. By degrees the bare, abandoned ground was colonised by birch and when, a canopy formed, natural spruce seedlings began to spring up in quantity. When we visited the area there was a complete understory of vigorous spruce, some well up in the now-lightening birch canopy.

In the reafforestation of the Jutland heaths it was found impossible to establish Norway spruce without first growing mountain pine as a "pioneer."

The value of "pioneer" species is now being recognised here and in Great Britain. In many plantations the beneficial effects of such species as contorta pine, Japanese and European larch, Scots pine on the development of spruce, Douglas fir and *Tsuga* can be illustrated. Plantings of spruce on light soils where heather is a normal, though sometimes temporarily insignificant component of the vegetation, usually go through a stage of check after planting which may last for years. It has been observed that where contorta or Scots pine has been introduced in beating up or was present from the first planting, the spruce nearest the pine come earlier out of check than is the case with those unmixed with pine. Similarly Sitka spruce mixed with European or Japanese larch show greater freedom from aphid attack or are more vigorous and healthy than pure crops on similar sites. Ecologists and mycologists have been busy trying to elucidate these phenomena and while much has come to light we are still far from a full explanation. We can, however, agree that Hayes of Avondale put the matter fairly concisely when he wrote that "Providence had wisely scattered the food of each plant over the surface of the earth, so that many trees of different species will grow well on an acre of ground where the same number of one kind would actually starve for want of nourishment."
