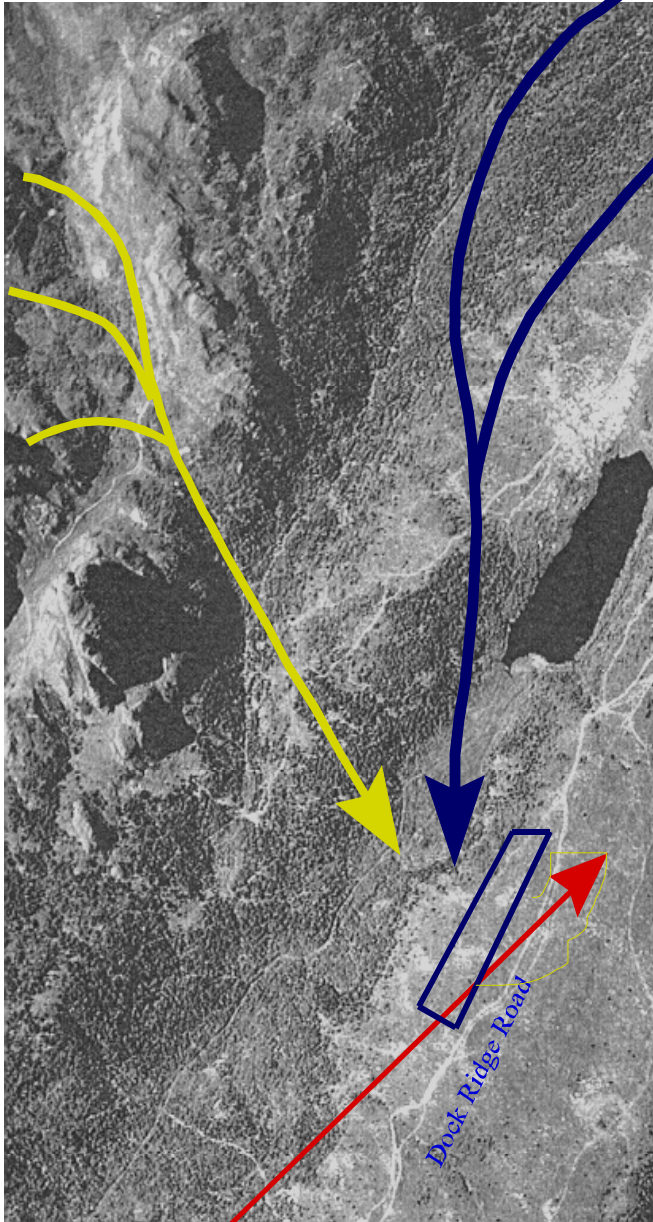


# DOCK RIDGE ROAD

This experimental plantation is located on top of a ridge opposite Agriculture Canada's experimental blueberry farm on Dock Ridge Road. The site was ploughed with a Parkgate plough with furrows 2 m apart and planted in 1970.



The 1944 aerial photo shows that, prior to planting, both sides of Dock Ridge Road had long been used for pastures, crops and, more recently, blueberry production. The arrows give a generalized indication of how the topography redirects and accelerates the flow of frequent westerly and infrequent, but strong northerly winds over the plantation site. As will be illustrated below, these flow patterns were deduced from wind thrown trees in and around the plantation. The brisk, persistent southwest winds during the growing season (red arrow) were determined by the deformation of tree crowns.

The yellow line on the east side of the plantation shows the extent of naturally regenerated Japanese larch.

1944 aerial photo showing extensive pastures on both sides of Dock Ridge Road. The experimental planting site is located on the west side of the road. Arrows give a generalized view of how the high ridge with bedrock outcrops and steep slopes(left) redirects and accelerates wind flow over the plantation site

The 1995 aerial photo shows a considerable expansion of forest cover west of Dock Ridge Road, much of it mature enough to be strip-cut.



1995 aerial photo showing considerably more forest cover (some of it strip cut) west and north of Dock Ridge Road. The 30 year-old plantation beside Dock Ridge Road is easily seen, particularly the plots of white spruce (WS), Japanese larch (JL), red spruce (RS) and hybrid larch (HL), respectively.

The photos on this page show how some species have grown 10 years after planting.



Japanese larch



European larch



Front-back: Red spruce, Scots pine and Japanese larch



White spruce



Corsican pine, Calabrian pine, Scots pine, Austrian pine and Japanese larch



Austrian pine

In terms of growth and yield, Japanese Larch followed closely by hybrid larch far exceeds that of other native and exotic species. There is quite bit of dieback - no doubt due to recurring infestations of the larch sawfly.

It has been speculated that die back results from late spring frosts. This seems unlikely. First of all, the persistent windiness of weather on the ridge is the opposite of a frost hollow. So, with adequate air circulation, late spring frost is not likely to be frequent: even if it was, larch readily recovers from minor bouts of frost. A more likely explanation is that larch, being a light demander, prefers open-growing conditions. Or, more to the point, relatively warm soils. Therefore it is necessary to thin early to increase the solar radiation receipt to ensure greater heat penetration into the soil earlier and for a longer period.



30 year-old Japanese larch stand on Dock Ridge Road. Average height is 12 m and dbh 17 cm. In 1998 it was thinned to about 2,000 stems  $\text{ha}^{-1}$ .



10 yr old hybrid (erroneously called European larch) larch on Dock Ridge Road. Average height is about 5 m and survival 90% or better.



The same stand at 30 years of age. Top height is 10-12 m, and dbh 16 cm. The stand was lightly thinned in 1998.



Careful thinning was carried out by conservation officers in 1998. Judging from the condition of the crowns, larch stands benefit from a combination of careful thinning and a couple of years of exceptionally good summers and mild winters.

Even, European larch, the least tolerant of the larches in harsh environments, looks very unhappy despite being well sheltered by dense stands of other exotic and native species, notably a dense plot of red spruce.

European larch thrives best in fairly open stands on sheltered sites with deep, well-drained and relatively warm soils. At best, the European larch is on moderately fertile, but shallow brown soils. It is partially sheltered from persistent south west and gale-force northwest winds by dense stands of exotic and native tree species. However, the stand has become too dense to allow for adequate levels of solar radiation to warm up the soil.



A fine specimen of one of the few surviving 30-year-old Hondo spruce.

A few Hondo spruces have survived. After a slow and uncertain start, they have had excellent leader growth in the past few years - no doubt benefited from the particularly long growing seasons and mild winters of late. They are between 5-6 m tall. Most have a distinctively sturdy stem bearing a narrow, ungainly crown form - except for a few well-formed trees which look very much like Sitka spruce.

Planted white spruce has performed well. Although it is a slow starter, relative to larch and fir, at 30 years of age it is beginning to accelerate its growth. Although it is on the windward flank of the experimental plots, it is obviously much more wind-firm than the larch - insofar as there is no sweep in the boles and relatively minor crown deformation. Also, while the stand was brashed in 1998, prolific natural regeneration extending windward of the plantation is providing a convenient barrier preventing too much wind from penetrating the plantation.

Survival of the New Brunswick provenance of red spruce, is virtually 100%. Being naturally a slow-starter, compared to other spruces, it is of comparatively small stature. At any rate leader growth of recent years indicates that its growth and yield will increase dramatically over the next decade or so. At 30 years of age, red spruce is as yet virtually indistinguishable from the naturally regenerated black spruce in the plantation. This is not surprising since there is still some taxonomic debate as to whether red spruce (*Picea rubens*) is a separate species or simply a form of black spruce. No matter, those of us with sharp eyes for variants easily recognize mature red spruce. The question is whether it will perform any better than black spruce in this location at least. The high influx of local black spruce into plots will provide the answer.

Survival of the three varieties of Austrian pine (Corsican, Calabrian and Austrian) is spotty at



30 year-old red spruce plot that was brashed when it was 29 years old. Barely visible at the far right and behind the red spruce are the sickly crowns of European larch.



A fine stand of 30 year-old planted white spruce (right) with vigorous natural regeneration of spruce, tamarack and balsam fir.

best. At age ten, some varieties survived better than others. Some mortality was due to natural causes - particularly dessication in winter. However, at 10 years of age, as the photo above shows, survival and healthy growth of Austrian pine in particular and to a lesser extent Corsican pine, was exceptionally good. Unfortunately, it was obvious from spade marks and digging holes, that a lot of the pine was dug up and carted off to gardens - making fine ornamental specimens indeed.

The Scots pine plot between the plot of Calabrian and Austrian pine, respectively, - and too handy to the parking lot - didn't fare much better. Most of them were carted off to gardens too. However, most of the Scots pine planted between the Japanese larch and red spruce plots are intact and have grown reasonably well - albeit suffering from the crown breakage due heavy freezing rain and snow loading as is expected

Windiness during the growing season is most obviously reflected in the larches. In fact, as shown elsewhere in the report, the relative crown deformation of larch gives a far better and instantaneous estimate of wind speed and wind direction and windflow patterns during the growing season than the purely technocratic methods using meteorological instrumentation, tatter flags or TOPEX scores. For example, the solitary tamarack in the photo sends a clear-cut message of the wind speed and direction of the site long before it was considered for planting.

A strong sweep of boles is often, but not always, associated with crown deformation. The sweep (curvature) of boles in the Japanese larch plot, which has been exposed to brisk, persistent winds since it was planted is obvious.

The hybrid larch plot is partially sheltered by the red spruce plot on the windward side. Hence, the sweep of boles is less pronounced than in Japanese larch. The hybrid larch plot is also sheltered on the north flank by natural woodland and, therefore, wind throw is minimal.



Bole sweep of Japanese larch due to brisk, persistent westerly wind.



10 yr old Corsican and Calabrian pine on Dock Ridge Road. The severe flagging of a much older, naturally regenerated tamarack is an obvious indication that the trees are subjected to brisk, persistent southwest wind

Further upwind, the sweep in the boles of European larch is negligible because of the shelter provided by the dense red spruce plot.

Of course, different wind directions at different time of the year have very different impacts on tree stands. For example, northerly winds, though infrequent and strongest in the fall, rarely persist more than a few hours. In the case of Dock Ridge area, the topography west of it can compress and redirect the flow of comparatively benign west and north winds into gale-force gusts which accelerated up-slope to the plantation.

Planting on furrows also contributes

to the instability. Presently, this not a problem. In compensating for the impact of persistent and frequently brisk southwest winds, larch has developed streamlined canopy profiles coupled with shifting the centre-of-gravity of trees downwards by concentrating more growth into strongly tapered boles and a larger root mass. Besides, within the next decade or so, the stand may be protected by the naturally regenerating native spruce and fir if they grow fast enough to provide some protection from the northeasterly winds.

Unfortunately, the larch is not so well adapted to the strong north winds: firstly, because they are infrequent; and, secondly, because the gale-force north easterlies usually occur when the larch is dormant - that is, they cannot adjust growth strategies to adapt to northerly winds.

Violent gusts have caused a blow out on the northern flank of the Japanese larch stand is not yet protected by natural stands of balsam fir and black spruce. The fact that, ploughing induces shallow rooting confined mostly along the turf reduces wind-firmness.



Endemic wind throw on the northern flank of the Japanese larch plantation due to up-slope wind.

Along the roadside and on the fields of the experimental farm many Japanese larch and possibly hybrid larch have naturally regenerated. 2-3 m tall predominates. Among them is one that appears to be a spontaneous hybrid between Japanese larch and tamarack (*Larix leptolepis* x *L. laricina*). The stem, bark and general form has the characteristics of Japanese larch: while the foliage (leaf fascicles) closely resembles tamarack.



For the past 20 years, there has been a considerable influx of balsam fir, black spruce and to a lesser extent tamarack and white spruce - especially into plots with low survival of planted stock. One would think that, because it is a ploughed site, there would be an obvious bias in the pattern of natural regeneration either at bottom of the furrow, on top of the upturned (and rotted) turf, or between the furrows. However, such a bias is not obvious. Naturally regenerated native species have essentially caught up or soon will with the exotics, except the larches.

Natural hybridization between larch is not unusual - the renowned Hørsholm Arboretum near Copenhagen in Denmark, has at least a dozen hybrid larches. But perhaps the most famous hybrid larch is the Dunkeld larch (a cross between European and Japanese Larch) that was discovered as a seedling in a nursery bed of two-year-old European larch. It turned out that the Dunkeld hybrid was superior in growth and yield and adaptability to a wider range of sites than either of its parents.



Branch of Japanese larch



Japanese larch x tamarack?



Tamarack



### LEE'S POND ACCESS ROAD

The site was ploughed with a Parkgate plough in 1966 and planting with Scots and Jack pine, Black, white and Sitka and Hondo spruce (one report also mentions Engelman spruce) and tamarack. Apparently, many of the seedlings were frost-heaved and washed out by erosion. Despite replanting, there is poor survival in at least half the plantation.



Lee's Pond plantation off the Avondale Access road. The poor survival and growth of planted stock in the centre of the plantation suggests there is a perennial high water table which favour natural regeneration of tamarack.

On the positive side, the furrows have encouraged vigorous natural regeneration of tamarack. That is until shrubs began dominating the understorey within the last decade or so. Along the margins of the plantation, particularly on the east side, which has a high proportion of grasses, natural regeneration of tamarack is exceptionally good. In fact, on the abandoned blueberry farms, along the Avondale access road, there is generally a higher than normal proportion of young tamarack.



Part of Lee's Pond plantation, which was ploughed in 1966, planted in 1967 and replanted between 1968-70. Both tamarack (left) and one of the few surviving Hondo spruce (right) have gotten off to a slow start; but showing signs of much better growth over the past few years. Note also, vigorous natural regeneration of tamarack in the understorey.



Part of Lee's Pond plantation showing mediocre growth of planted tamarack and one of the few surviving white spruce (left of centre). In contrast to the adjacent photo a dense understorey of shrubs is effectively restricting natural regeneration of tamarack

Among the tamarack, there are a few Sitka and Hondo spruces which are only now beginning to show signs of good growth. The best part of the plantation is a mixture of Scots pine, Jack pine, tamarack and black spruce, and a few white spruce. The top height of tamarack is 10-12 m and dbh in the range of 14-19 cm. In terms of growth and yield, there is not much difference between Scots pine and Jack pine - their top height being 8-10 m and dbh in the range of 14-18 cm. Being close grown, both tamarack and pine have better form than usual for such a harsh site. The top height of black spruce is 7-9 m and dbh 10-14; however, as expected, they have a better form (from sawyers point of view) than tamarack and pine.

Despite the abundance of cone production on Scots and Jack pine, there is no sign of them naturally regenerating.

If this type of relatively slow-growing mixed-species plantation was upscaled to a commercial plantation, it could conceivably be designed as three-crop rotation: i.e., an early crop (40-50-year rotation) of pine for rough timbers; a middle crop (40-60 year rotation) of tamarack for specialty timbers, and a final crop (60-100+) of spruce for high-grade timbers. Naturally, in-planting following extraction would perpetuate the timber stock.