Pests and Diseases of Sitka Spruce

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Introduction

SITKA spruce (*Picea sitchensis* Bong. Carr) is undoubtedly the most important tree species in Irish forestry. It represents approximately 45% of the forest estate in Ireland. The species is an exotic introduced from North-West America.

These two factors determine that a keen interest be taken in insect and disease problems associated with Sitka spruce. Firstly, because of its dominant position in Irish forestry, if serious pest or disease problems are to arise with the species considerable loss in wood production could be anticipated. Secondly, it is internationally recognised that introduced exotic tree species are inherently more vulnerable to pest and disease organisms than are indigenous tree species.

Bearing these two points in mind we will examine the present situation with regard to pests and diseases of Sitka spruce in Ireland and also look at potentially damaging organisms which do not occur in Ireland and the measures which are adopted to minimise the possibility of inadvertent introduction.

Insects

At present there are only two insects of economic significance attacking Sitka spruce; the large Pine Weevil (*Hylobius abietis* L) and the Green Spruce Aphid (*Elatobium abietinum* Walker).

The large Pine Weevil is a familiar insect to most foresters. Its population builds up in the stumps of coniferous trees following clearfelling operations. The damage is done by the adults feeding on the bark of young conifers which are planted on the clearfelled site.

TABLE 1

Effect of Didicol and Gammolin on the control of *Hylobrius abietis* attack on Sitka spruce

	Sitka Spruce Percentage Survival		
Year	Control	2.5% Didicol	5% Gammolin
1966	82	86	92
1967	15	68	84
1968	1	51	63
1969	1	47	61

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Unless protective measures are taken against this insect, the replanted crop will suffer very heavy damage; quite frequently this will result in complete mortality of the trees in the area replanted (Table 1).

Currently protection is achieved by dipping the plants prior to planting in 2.5% DDT or 1.6% Lindane (gamma–BHC). The importance of this insect is likely to increase in the future when the clearfelled area is substantially greater than at present. Increased clearfelling will probably also lead to difficulties with root feeding. *Hylastes* spp. notably *H. cunicularis.*

Another factor to be borne in mind in relation to the large Pine Weevil is the general opposition which is developing to the use of persistent chlorinated hydrocarbons. This may necessitate changing to other types of insecticides. It is necessary therefore to continue screening new insecticides in the search for suitable alternatives to DDT and Lindane. We are of the opinion however that the limited use of DDT and Lindane for the control of the large Pine Weevil does not constitute a serious environmental hazard.

The other important insect attacking Sitka spruce is the Green Spruce Aphid. This is a sap feeding insect which feeds on the needles of Sitka spruce. It defoliates all but the current foliage in late winter and spring. Foresters have traditionally held the view, that while the insect causes dramatic defoliation of the tree, recovery is rapid and tree mortality does not occur. Consequently the insect was not considered to be of any great economic significance.

Interest in the insect has increased greatly in the last 8-9 years, during which period there has been 6 bad aphid years. This greatly increased frequency of bad aphid years is thought to be primarily due to the very mild winters experienced in the last 9 years resulting in very improved winter survival of the aphid. However, in spite of the increased frequency of attack tree mortality has not occurred. We have commenced an investigation into the effect on the growth of Sitka spruce caused by defoliation by the Green Spruce Aphid. Preliminary results indicate that one year's complete defoliation can result in a reduction in leader growth of 50% (Fig. 1).

These results suggest that economically significant growth losses may be experienced by Sitka spruce crops if they are attacked by the green spruce aphid a number of times during the rotation.

There are of course very many other insects which attack Sitka spruce besides the two which have been discussed above. None of these however, at present, constitute a serious threat to Sitka spruce production, although many such as needle miners (*Epinotia* spp.) do become locally abundant from time to time. It is important to keep an eye on these, at present, unimportant insects. They may at some time in the future become abundant. The reasons for insect

pests reaching outbreak status are not clearly understood. There are many examples of insects which have been of little or no significance for long periods suddenly erupting into outbreak status Examples of these are the outbreak of the larch sawfly (*Cephalcia alpina*) on larch in Wales in the early 1970s which is still continuing. More recently, the Pine Beauty (*Panolis flammea*) which has been in Great Britain for at least 50 years erupted on Lodgepole pine in Scotland in 1976. On spruce, the European Spruce Sawfly (*Gilpinia hercyniae*) has reached epidemic proportions in Canada (1930) and in Wales (1971), having been in both countries for many years before reaching outbreak status.

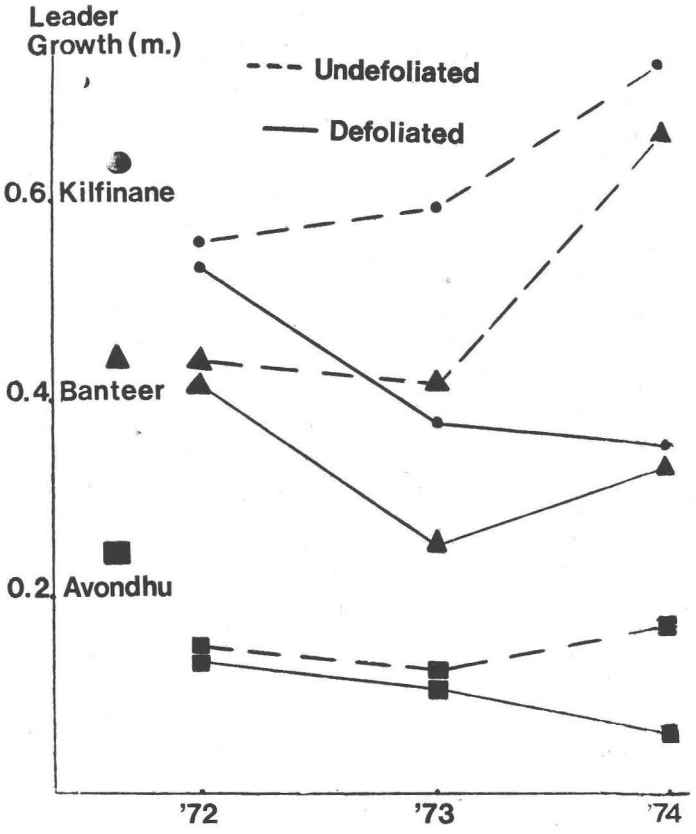

FIGURE 1: Influence of Green Spruce Aphid defoliation on height increment (m) of Sitka spruce at Kilfinane, Banteer and Avondhu forests.

The point here is that one cannot make assumptions that because an insect is at a low population level it will remain so. We cannot therefore ignore the possibility of low level pests occurring in Ireland at present assuming economic significance in the future.

Mention has been made of the European Spruce Sawfly. This insect does not occur in Ireland. It has proven ability to be severely damaging on Norway and Sitka spruce. Among other European insects which do not occur in Ireland are European bark beetles, *Dendroctonus micans, Ips typographus, Ips amitinus* and *Ips sexdentatus*. These bark beetles on their own or in combination with other harmful organisms such as the Green Spruce Aphid or the Honey fungus (*Armillaria mellea*) would constitute a very serious threat to Sitka spruce in Ireland.

Apart from these European insects there are many potentially harmful North American insects. Among them may be mentioned the spruce budworm (*Choristoneura fumiferana*), the black headed budworm (*Acleris variana*), the western hemlock looper (*Lambdina fiscellaria lugubrosa*), *Hylobius* spp, the Sitka spruce weevil (*Pissodes sitchensis*) and the Engleman spruce beetle (*Dendroctonus obesus*).

It is obvious that adequate protective measures to prevent the inadvertent introduction of these and other insects and diseases must be taken. The measures which have been adopted are reviewed later in this article.

Diseases

Natural forests have their own inbuilt system of checks to guard against the ravages of disease epidemics. It seems that the interspecific and intraspecific diversity of natural ecosystems provide a broader genetic base that greatly enhances the capacity of the forest to withstand threats from the major pathogens. Such is not the case with our Sitka spruce monocultures. These forests are so designed to produce fast-growing uniform trees, selected to meet rather specific consumer needs. They are often located on sites chosen more for socio/economic reasons than for suitability to the biological requirements of the tree. Such intensively managed forests are therefore subject to many disease problems that differ greatly from those of their natural counterparts. Instead of heart rots for example, and other diseases associated with old age and decadence, root rots, stem cankers, foliage diseases and physiological disorders are much more common.

It is less than three-quarters of a century ago that Sitka spruce was first planted in a State forest, at Avondale, County Wicklow. Since then, many disease problems associated with intensive culture of the species have become apparent throughout the country. In its

native North West America, Sitka spruce is affected by more than one hundred and twenty pathogenic fungi. By contrast, not more than ten major diseases affect the species here in Ireland. The protection afforded Sitka spruce by virtue of our island status is our natural and most important phytosanitary asset. This fact is internationally recognised and forms the cornerstone of our plant health legislation. The uniform composition of our spruce forests made up of a first generation exotic conifer makes them inherently susceptible to introduced harmful organisms. In order to maintain a relatively disease-free situation, an integrated disease control programme needs to be practiced and enforced by legislation (see Table 2).

Of the major pathogens affecting the species in Ireland at present *Fomes annosus, Armillaria mellea,* and *Rhizina undulata* may be listed as being the most damaging agents of death and decay. The greatest short-term danger to Sitka spruce as grown in short-rotation plantations in Ireland lies with these three unrelated root-rotting fungi. Members of this group are not host-specific, and their infective spores are ubiquitous. Control measures to counteract heart rot caused by *Fomes annosus,* mainly centres on stump protection. A 10% solution of Sodium Nitrite or 20% Urea applied to the stump as soon as possible after felling is the current protective measure practised in Irish forests.

TABLE 2

Principles of disease control programme for Sitka spruce

Integrated Disease Control Programme for Sitka spruce

Principle	Method
Resistance	Regulatory
Eradication	Cultural
Exclusion	Biological
Protection	Physical
Avoidance	Chemical
Therapy	

Biological control of this disease on Sitka spruce through the use of antagonistic microorganisms is a future possibility. Research work indicates that the fungus *Hypholoma fasciculare* could be the candidate organism. When one considers that there is over 5% loss in timber production due to *Fomes annosus,* it is economically desirable that protective measures be rigidly enforced. This is particularly true of those areas now at first thinning stage which are, as yet, free of the disease.

Restriction of burning might be expected to control the Ascomycete fungus *Rhizina undulata*. However, clearfelling of unproductive forest areas and their subsequent replanting with Sitka spruce after burning of lop and top, predisposes the replanted trees to infection. Control measures here also include cultural and physical methods whereby the lop and top is wind-rowed and left in situ. The inoculum potential of the fungus is dissipated after 2-3 years. Leaving the burned site fallow for that period of time is a control measure practiced in the Netherlands. *Armillaria mellea* causes root necrosis and rotting of Sitka spruce. The disease is more common on old hardwood sites. It is also thought to colonise root wounds and to predispose roots to infection by *Polyporus schweinitzii*. Its general role however is that of killing trees already weakened by insects, defoliation, drought or poor soil conditions. The disease has also been recorded on Sitka spruce in association with damage by barkbeetles. As yet there is no economically feasible control measure formulated to counteract this pathogen.

Polyporus schweinitzii causes a brown cubical butt rot, which is by far the most damaging fungus disease of Sitka spruce in either North America or Europe. Its incidence in Ireland is rare. As our forests mature it may constitute a serious threat. It is normally described as a parasite of middle aged and mature trees and in Europe it has been associated with extraction damage. Another potentially dangerous pathogen associated with extraction damage on spruce is the Basidiomycete *Stereum sanguinolentum*. It can cause serious butt rot damage but its disease status in Ireland is minimal at present. One of the principal root-rotting organisms of Sitka spruce in its native habitat is *Poria weirii* which again fortuitously does not occur in Europe. Only strict phytosanitary controls will prevent this potentially devastating fungus from infecting our spruce forests. It causes a laminated root rot and a method for its economical control is unknown. The fungus is not host specific and would pose a major threat to most of our forest estate.

Sitka spruce is a shallow rooting tree and heavy losses have been sustained by the species due to windblow damage. It is highly susceptible to decay when blown and is readily colonised by various cellulolytic and lignolytic decay fungi. *Odontia bicolor, Sparassis crispa* and various *Polystictus* spp. are the major decay organisms concerned. The objective of forest management in such windblow situations with this species should be to harvest the timber as soon as possible to prevent further degrade. Another feature of Sitka spruce outplanted on our oligotrophic peats and Old Red Sandstone areas is its tendency to go into check. This problem is associated with nitrogen unavailability and general lack of biological activity

in the rhizosphere. Could this problem be due to lack of the appropriate mycorrhizal symbiont? Although there is no good evidence that mycorrhizal fungi themselves are directly involved in nitrogen fixation there is some indication that the mycorrhizal system does somehow stimulate fixation. Disease resistance against soil borne pathogens has also been attributed to the presence of beneficial mycorrhizae on Sitka spruce roots. The proper symbiont produces a very potent anti-fungal and anti bacterial chemical that inhibits the invasion of the feeder roots by disease organisms such as *Phytophthora cinnamomi.* Direct nursery inoculation of Sitka spruce seedlings with specific mycorrhizae is an area of research that shows great promise.

Looking to the future as regards disease problems of Sitka spruce it would seem that an increasing number of stem rotting fungi will become established in second rotation crops. Biological control will play a greater role in disease prevention and inevitably forestry practice will increasingly incorporate techniques for manipulating and encouraging desirable microbial systems. Stricter phytosanitary measures will have to be enforced to guard against the introduction of undesirable pathogens. Particularly in this regard may be mentioned the rust fungi *Chrysomyxa arctostaphyli, Melampsora medusae* and *M. occidentalis.* An eradication programme will have to be initiated against the soil-borne pathogen *Phytophthora cinnamomi.*

Strict adherence to an integrated disease control programme as outlined in Table 2 should help to contain any major disease problems we have with Sitka spruce at the moment. Future disease problems should be minimised when the E.E.C. Directive on plant health is operational. Provided these control measures are adopted Sitka spruce will remain our major timber producer and its most important role in Irish silviculture will be assured.

Plant Health Control of Imports

Up to the present time we have protected ourselves from unwanted insect and disease introductions by operating national import controls. These consisted primarily of import prohibitions of plants of our major tree species, including Sitka spruce. We also prohibit the introduction of conifer wood with bark from certain European countries, this provision is intended to give protection against the introduction of European bark beetles.

From the 1st January 1979 we will have to operate an E.E.C. Directive on plant health which will significantly modify our national controls, but which will afford us with greater protection in many areas. Specifically with regard to Sitka spruce the main provisions in the Directive are.

1. The importation of spruce plants into the Community from Non-European countries is prohibited.
2. The importation of wood of conifers with bark attached, into the Community from temperate regions outside Europe is prohibited.
3. The importation of wood of conifers with bark attached into Ireland from Europe is prohibited.

It is worth noting that for plant health purposes the whole island of Ireland has been treated as a unit, so that the provisions in the Directive are identical for the Republic and Northern Ireland.

The measures outlined are Community ones, but this does not prevent Ireland taking stricter precautions against countries not belonging to the Community.

Summary

The present situation in relation to the more important insect and disease problems associated with Sitka spruce in Ireland are outlined. The potential of presently unimportant organisms are discussed. The threat posed by inadvertent introductions of harmful organisms not present in Ireland is examined, together with the plant health control measures being adopted to minimise the possibility of such introductions.

Discussion following the papers of G. de Brit and D. McAree

CHAIRMAN: **C. S. Kilpatrick**

In reply to a query from **Dr. Joyce** concerning the potential risk from an introduction of *Dendroctonus,* **Mr. de Brit** said he did not see any danger of *Dendroctonus* getting into the country in the foreseeable future. There followed some discussion on the E.E.C. Directive on plant health. **Mr. Saville** asked about the possibility of biological control measures being employed against the Green Spruce Aphid. **Mr. de Brit** explained that the problem with biological control lay in the lag between attack and the introduction of the predator, making it impossible to prevent damage completely. The predator population usually does not increase until after the build up of the attack.

Mr. Deasy mentioned that Sitka spruce mycorrhizae occur naturally in most forest nurseries and questioned why nursery practice should be modified to encourage the development of these

fungi. Mr. McAree agreed but mentioned that present nursery practice in Ireland is such that the growth of *specific* mycorrhizal fungi is not encouraged. Direct nursery inoculation of seedlings with mycorrhizae ecologically suited to various site types should be considered.