CSNN Update.

What we know, what we think we may know, what we don't know - & what we need to find out.

What is CSNN - Current Season Needle Necrosis

* It affects current year needles only which become initially yellow then brown from tip to middle of needles.

* It may first seen 2-4 weeks after flushing in trees planted two or more years, leader and top whorl often unaffected.

* Symptoms continue to developed until August when many affected needles will drop.

* It typically occurs on single trees or groups, but with no particular pattern of infection.

* It may not reappear following year, but is generally repeated year on year. Tree height and girth usually unaffected

What causes needle necrosis in Nordman Firs?

* The fungus Sydowia polyspora is associated with the condition, a ubiquitous pathogen which we understand can be found on any tree species without causing problems until the tree is negatively affected by other stress factors.

* As yet, no particular stress factor has been identified, but possible sub clinical herbicide damage, low calcium, current cultural practice, waterlogging or damaged root systems have all been suggested, but not proven.

* It has also been suggested that growing Nordman Firs out of their natural habitat may also be a factor, but although the UK and Denmark are predominantly marine climates, and so could be said to fit this criteria, the problem has also been experienced in the very continental climate in Finland.

When and where has it become a problem?

* Needle necrosis has been with us at low or very low levels ever since Nordman Firs have been grown in the UK.

* Major problems were first reported in the UK in 2011

* CSNN has not been a particular problem in Denmark until 2012. It is thought that this was the result of dramatically increased spore production in the very wet early summer in Denmark the previous year.

* Problems have also been reported from Ireland and Austria.

* CSNN has been a major problem in lowland Noble firs in the western USA for many years.

* The 2012 April BCTGA survey indicated that it is more of a problem in the drier south and east of the UK

* More plantations have been reported as suffering from the condition in 2012, but part of this will reflect greater awareness of the symptoms.

Weather and topography

* It is likely that wet weather will encourage the spread or intensity of the disease, although paradoxically the first major problems were found in the drier areas of the UK - the east and southeast, during a particularly hot dry year.

* Symptoms appear to follow wet warm weather (particularly thunderstorms) when succeeded by hot dry weather and bright sunshine.

* Even light wind will be sufficient to spread airborne spores a considerable distance.

* In USA condition related to high temps at early flush in May / June, particularly in Oregan if wet during elongation.

* Work in the Pacific Northwest has, though, demonstrated a climate / topographical effect. Infected transplants from ten sources were planted on a lowland site and a mountainside site. The lowland trees suffered moderate to severe symptoms, while the same trees on the upland site show no or minimal symptoms.

Seed Infection

* It has been shown that some Nordman seeds carry moderate to heavy levels of infection with S polyspora, while others are free from the fungus.

* When young seedlings are inoculated with spores, symptoms appeared after 1 month. Untreated showed no symptoms or infection

* Trials on widely differing plantations in the USA demonstrated that the degree of infection between the seed sources followed the same trend - ie those which were the most severely infected on Site A also showed the most symptoms on Site B.

* Seed infection may be genetically influenced, with seeds from individual trees being more liable to infection. In one study infection varied from 0.5 to 87%.

* Infection may be suppressed by thiram or thiabendazole seed dressings or foliar fungicides used in some forest nurseries. No UK supplied seeds have been dressed to date, but this years UK seed supply will be treated with thiram.

* It has been suggested that plants sourced from nurseries outside of the UK which produce many millions of Nordman transplants may be more prone to infection due to intensity of production if fungicide programmes are not being followed.

* Infection may be influenced by seed handling - it has been shown that the fungus decays in the seed with time, and therefore seed from stored cones may be free from infection. UK sourced seed is sold within 6 - 8 months of collection, while many Danish suppliers store seed for over a calender year.

Needle Infection

* There are strong suspicions that poorly waxed needles are more susceptible to necrosis than well waxed ones - hence new needles show symptoms while well waxed older needles do not.

Reduced levels of wax may be associated with:

- high levels of nitrogen producing soft needles
- low levels of calcium leading to reduced wax formation
- spring use of insecticides. These often have aggressive wetters which may reduce wax levels.
- interaction with glyphosate. it has been noted that trees adversely affected by glyphosate can show greater necrosis and needle loss. However, on these trees, the shoot end needles showing typical glyphosate needle damage do not appear to suffer from necrosis.

One possible line of investigation would be to protect the new needles with a product such as a spraying oil.

The fungus

* S polyspora is thought to come from the ascomycetes family of fungi, although this has yet to be confirmed. It causes blue stain disease in Pine timber and is possibly similar to apple scab, black spot in roses and blackcurrent leafspot.

* S. polyspora is the perfect (sexual) stage of the fungus, and the imperfect (asexual) stage is Hormonema meriodes. Other papers suggest that the perfect stage is Schlerophoma philiophalis or Sclerotina philiophalis. This means that there is the potential for aggressive mutations to appear, although plant pathologists regard this as unlikely.

* It spreads by two types of spores - conidiospores produced on a fruiting body (the conidia) which firsts infects the needles, and then ascospores - the latter in vast numbers which lead to further infection and the necrotic symptoms.

* Spores from infected needles are likely to be the predominant source of infection, but the fungus is understood to be found on any tree species, so spores may therefore infect the crop from external sources. It is possible, therefore, that other tree species reacting to stress by producing massive spore numbers may infect Nordman fir.

* The maximum period of spore production is likely to be during early flush in May, leading to rapid infection of soft needles with little wax protection. It is probable that spore production continues through the summer - but knowledge of this is very limited.

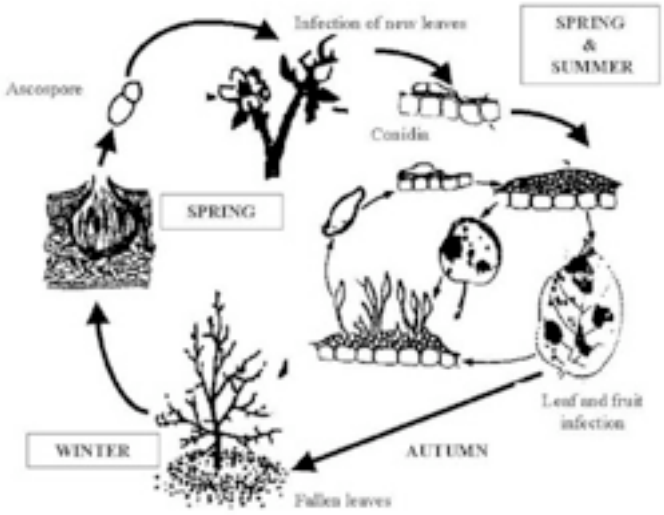
* Spores produced during the summer also infect both new and older needles without showing any symptoms - this has been demonstrated by growing the fungus from needles showing no symptoms.

Life Cycle

Possible S Polyspora Life cycle

April / June	Ascospores are released from previously infected trees and needles. These germinate and penetrate the new needles and produce conidia. These produce conidospores spread by rain and wind, & typically require wet needles to germinate and infect.
July	One some trees this infection result in needle necrosis and needle loss. Other trees, while carrying the infection, show no symptoms.
July - Sept	Further conidia are developed in infected needles which further infect needles and needle litter on the ground.
Oct - Apr	The fungus overwinters in infected needles and needle litter on the ground.

Apple Scab life cycle (Blackcurrant Leafspot and Rose Blackspot are all similar)



Fungicides

* Mycelial testing on agar substrates in the laboratory has shown that a number of fungicides incuding Cercobin thiophanate methyl), Topas (penconazole), Dithane (mancozeb) and Stroby (kresoxyyn methyl) will control the fungus. However, when these fungicides have been tested with single and multiple applications in the spring / summer, these have been unsuccessful in controlling the disease.
This may be because the infection pressure is too great at time of maximum spore production during flushing, or that the use of systemic fungicides to control mycelia in needles during late summer / early autumn may be more successful.

* Bayer see this as a useful market and are aiming to commence fungicide trials in 2013.
Other manufacturers including Cewrtis, Syngenta and BASF are also co-operating. with the BCTGA.

Working in isolation, or cooperating with other associations.

* Jan Jurgensen of the Danish Christmas Tree Growers Association is stated to be initiating a research programme. Should the BCTGA consider working with the Danes on this project? If so we should make early contact to judge whether this is in our joint interests.

* The Pacific Northwest Christmas tree growers have been working on this problem for many years, and cooperation here will not be influenced by any marketing politics.

Main Actions Proposed

* Conduct an in depth survey of cultural practices of selected UK growers
* Continue to identify, absorb and analyse current and past research from Scandinavia and the USA.
* Contact major UK forest nurseries to recommend suggested fungicide programmes
* Commence a limited late summer / early autumn field trial with fungicides in cooperation with pesticide manufacturers.

Colin Palmer
3rd September 2012