LOGGING INDUSTRY RESEARCH ORGANISATION

P.O. Box 147,
ROTORUA,
New Zealand.
Telephone: 07-348-7168
Facsimile: 07-346-2886

TECHNICAL NOTE TN-26

Sapstain Management Part One:

An Introduction to Sapstain

In many of New Zealand's export markets sapstain is a tolerated but undesirable feature of radiata logs. To increase log quality for higher value end products, sapstain degradation must be reduced or eliminated.

FUNGI

As soon as a tree is felled it loses its natural immunity and is open to attack by a wide range of fungi. Fungi live on living plants or animals (parasitic fungi) or dead organic material (saprophytic fungi). Some exist as single celled organisms while others form continuous chains of fine threads known as hyphae. Many hyphae interwoven together make visible threads known as mycelium.

Fungi reproduce by emitting large numbers of spores. A 10 cm mushroom will release a thousand million spores into the air in just a few days. Some spores are airborne, while some are sticky and are transported by water or insects. Very few spores however, land on a suitable substrate under conditions of moisture, aeration and temperature that allow germination to occur. At germination, the spore puts out a germ tube. If food is available, this tube elongates and branches to form a web of hyphae. As soon as conditions become unsuitable or food runs out, the fungi become dormant or produce spores.

Three main types of fungi attack logs: mould, sapstain and decay fungi. All three can cause unacceptable degradation.

Figure 1 - Log ends showing sapstain wedges

MOULD

Mould hyphae penetrate wood but obtain nutrients from the non-structural components of wood (that is, they do not utilise lignin or cellulose). They do not cause any loss of strength and the hyphae are colourless, so do not change the appearance of the timber. Mould can be seen as masses of coloured spores on the surface of the wood and can often be brushed or planed off.

SAPSTAIN

Sapstain fungi are similar to moulds in that they obtain nutrients mainly from the non-structural content of cells, especially the ray cells (long cells which run from the outside of the log to the core). As the hyphae invade these cells and penetrate into the log, the wood becomes a blue-black colour, often seen as dark wedges on the ends of logs (Figure 1).

The two most important sapstaining fungi are *Diplodia pini* and *Ophiostoma piceae*. These produce sticky spores which are present in the soil and are spread by insects, water, physical contact with the soil or mechanical means. These fungi also produce lighter, airborne spores during one stage of their growth.

DECAY

Decay fungi have enzymes which allow them to utilise the structural components of wood, the lignin and cellulose that make up the cell walls. Early stages of attack are shown by brown discolouration and some wood damage. Mechanical strength of the wood is reduced.

CONDITIONS FOR ATTACK

After felling and trimming, any wood not protected by bark may form a suitable substrate for fungal spores to germinate. This will include cut or broken ends of the stem or branches. The density of spores on an area of substrate also determines the severity and speed of attack. Dragging wood on the ground during extraction may cause high concentrations of spores to be applied to the exposed wood. Insects can also transfer large numbers of spores to cut surfaces. Spores may also be present on the tree before felling, and in occluded branch stubs from pruning operations.

Once spores are in place, conditions must be suitable for germination. The time needed to germinate spores under optimum conditions is not known but may occur within 24 hours. Once germination has occurred, the hyphae can start growing into the wood. However, hyphae growth cannot occur while the moisture content of the wood is high. The hyphae cannot grow into cells which are completely water filled and have no air pockets. Fast hyphae growth will only occur when wood drops to below 80% moisture content (by weight).

Immediately after felling, especially in the spring, radiata pine frequently has sapwood moisture contents well above 100%. Conditions of high humidity assist spore germination but inhibit logs from drying, so spores may often germinate, then wait on the surface of the logs for drying to occur before initiating hyphae growth. When conditions are suitable for hyphae to develop, growth rates may reach 1 mm per day (Lindgren, 1942). Debarking and anti-sapstain spray treatments should ideally occur before hyphae grow deep enough into the wood to be out of reach of the treatment system used.

As yet, the time needed for spores to concentrate on suitable substrate, for germination, wood drying and then hyphae growth into the wood is not known. Best guesses have traditionally been that the time from felling to treatment should be no more than three days in the summer and 10 days in the winter in the North Island. Where orders are for stain-free logs, forest owners are currently aiming for "fell to treat" times between 24 and 72 hours (depending on perceived risk). New Zealand Forest Research Institute is currently investigating sapstain development time under a range of climatic conditions. LIRO has been looking at logging and transport systems which reduce the time between felling and sapstain treatment or delivery to buyer. These are summarised in further reports.

This article is based on the work of R. Wakeling, New Zealand Forest Research Institute and:
Butcher, J. A. (1974) : A Practical Guide to Fungal Damage of Timber and Wood Products. N.Z. Forest Service Information Series No. 65.

Lingren, R.M. (1942) : Temperature, Moisture and Penetration Studies of Wood-Staining Ceratostomella in Relation to their Control. U.S. Dep. Agric. Wash. Techn. Bull. No 807, 35pp.

Alastair Riddle,
Researcher.

May, 1996