Goodbye Nematodes
Heat-Treating Southern Pine Lumber

VOCABULARY
Vocabulary in article indicated in italics

Bolts
Short, round sections of logs

Conifers
Evergreen trees containing pine needles or true cones

Infestation
Large amount of parasites swarming an area

Kilns
Oven used for burning, firing, or drying substances

Lumber
Boards sawed from logs

Moisture content
The amount of moisture an object contains

Nematodes
Parasitic, microscopic eel worms

Sapwood
The soft wood beneath the bark of a tree

Stem
The main trunk of a tree

Some scientists are interested in solving problems that involve international **policy**. When the United States tries to sell, or export, goods abroad, we must respect the policies, or regulations, of the other countries. In some cases, the policies of other countries can make exporting goods very difficult or expensive. The scientist in this study wanted to show people who export *lumber* how to prevent the spread of destructive organisms that live in the *lumber*. He wanted other countries to feel comfortable about using lumber from the United States so that their policies would not cause lumber exporters to spend too much money unnecessarily. Therefore, he studied ways to kill the organisms using the least amount of time and money.

Here's the head of a pinewood nematode, magnified 13,000 times. This worm is actually so small, it can only be seen through an electron microscope.

Adapted from:
Dwinell, David L. 1990. "Heat-treating and drying southern pine lumber infested with pinewood nematodes." *Journal of Forest Products.* 40:53-56.

Introduction

Lumber is an important product produced from trees. The production of quality lumber is very important, especially when two countries are involved in exporting goods to one another. The European Union acquires lumber from the United States. They are now making it mandatory that the United States put the lumber into *kilns*, which are ovens. This kills any organisms that may damage the lumber and spread diseases to the European forests. Lumber mills are now responsible for using kilns due to the regulations, or policies, of other countries. Dave Dwinell is a scientist who studies harmful organisms on lumber. His studies include ways of treating the lumber after it has been infested with organisms such as the pinewood nematode, which is a small microscopic worm, to assure that the European Union receives healthy wood. The pinewood *nematode* may cause weaknesses in many different types of *coniferous* trees. The *nematodes* rarely affect living trees, but are usually found in wood chips or in trees that have recently been cut down. For this reason, Dr. Dwinell has begun studying heat-treating techniques to kill the pinewood nematodes in the lumber. He wants to find out if high temperatures will kill the nematodes without having a major effect on the *moisture content* of the wood. This is very important due to the fact that if lumber dries out, it may split and become unusable.

Reflection

1 What problem is the scientist trying to solve?

2 Why is this problem important to people who export lumber?

Methods

To determine if heat-treating techniques could be used to kill pinewood *nematodes*, two 12-year old slash pines were cut down at the Baldwin State Forest near Milledgeville, Georgia.

The *stems*, or the main trunks of the trees, were cut into 5-foot-long *bolts*, or sections, and stacked up. To make sure that the *bolts* were infested with *nematodes*, 0.5 inch holes were drilled on one side of each of the sections, and *nematodes* were placed in each of the holes. The *bolts* were cut into lumber three weeks later at a sawmill. In addition to the slash pines, three 16-foot loblolly pines and two other slash pines collected from a previous natural *infestation* were also sawed into lumber.

The boards were weighed so that the amount of moisture lost in the *kilns* could be monitored at the end of the heat-treating procedures. Because wood is heavier when it has a lot of moisture, the loss of moisture can be determined by subtracting the weight recorded after heat-treating.

Many tests were conducted to determine which temperatures would be most effective for killing *nematodes* and protecting the lumber as well. Heat sensor probes were inserted into the boards. These were placed in the *kilns* to determine how much time it would take for the temperature inside of the wood to reach 60° C, 71° C, and 97.6° C. Other boards were allowed to air-dry in buildings so that a different drying method could also be evaluated.

Results

The scientist found that all procedures used were effective in killing the *nematodes*. The boards placed in a *kiln* for 24 hours at a temperature of 97.6° C contained no *nematodes*. The *moisture content* of the wood did drop, however. Before drying, the wood contained 25 percent moisture. After drying, the wood contained 7 to 9 percent moisture. This means that 64 percent of the moisture was lost (Fig.1).

The pine *lumber* that was dried in the *kiln* at 71° C was also free of *nematodes*. *Moisture content* dropped slightly from 34.3 percent to 30.3 percent. This meant that the wood only lost 12 percent of the moisture.

Dr. Dwinell found that it took one hour to kill *nematodes* at a temperature of 60° C. He tried lower temperatures, but they were not as

Reflection

1 Why do you think the scientist also studied pines from natural infestations?

2 What do you think will happen to the namatodes on the lumber placed inside of the kiln?

3 What do you think will happen to the nematodes in the air-drying process?

effective. He determined that treatment at 60˚ C was most effective because the *nematodes* were destroyed quickly and very little moisture was lost from the *lumber*. Dr. Dwinell also found that moisture loss was responsible for killing the *nematodes* in the air-drying process. The problem with this method was that it took the *nematodes* two months to die.

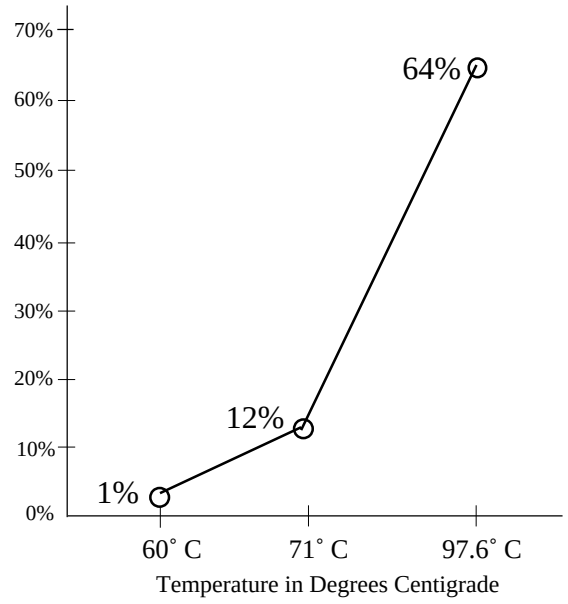

Fig. 1 Notice that moisture content decreases at higher temperatures. Therefore, 60˚ C is the ideal temperature to use

Discovery

Divide into teams of four. Each team selects one tree at the school. You will perform a similar experiment to Dr. Dwinnell's heat treatment experiment. Carefully break off two twigs from your tree. Make sure that they are approximately the same size. One will be the experimental twig and the other will be the control. Study the twigs carefully and record your observations carefully on a seperate sheet. Weigh each twig and record the weight, time and air temperature. Set the control twig aside. Place the experimental twig in a microwave for three and a half minutes. (That's the time it takes one cup of water to boil in a microwave). Record the temperature (212 degrees F) and the time (3 1/2 minutes). CAREFULLY remove the twig and allow to cool. Record the weight of your twig. Does it weigh less than it did before? If so, why do you think that is? Compare to the control twig.

Wait several more days. Record the air temperature and the time, and measure the control twig. Does it weigh less than it did before? If so, why do you think that is? If not, why not? Does it weigh less than it did the second day? If so, why do you think that is? If not, why not? Compare it to the experimental twig.

Reflection

1 What factors determined the death of nematodes in the heat-treating procedures?

2 Both heat-treating and air-drying were effective in controlling pinewood nematodes. What are the advantages and disadvantages of each method?

3 What method of pinewood nematode control would you recommend? Why?