MOISTURE RELATIONSHIPS IN *P. radiata* AND FIRE EFFECTS.

INTRODUCTION.

The prescribed use of fire is by far the most efficient and effective means of reducing the fuel levels in Pine stands. However, there is an element of danger involved. This is primarily scorching due to heat from the burn. The problem of fire intensity and scorch is amplified when standing trees are under drought stress.

Questions we must ask are;

(a) How do we measure the moisture relationships of the stand?
(b) What are critical needle moisture levels?
(c) What fire intensities have what drying effect on the needles?

The follwoing is proposed to aid in answering these questions.

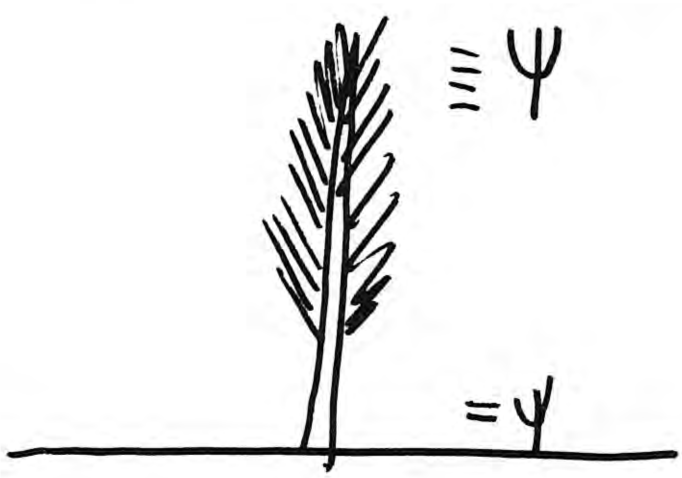
PREAMBLE

In a burn, needles are heated. This heat is lost by:

(a) radiation (known to be small)
(b) convection
(c) latent heat loss.

It is latent heat loss, or evaporation, which is most important. Unfortunately, it is this drying effect by hot air from fire which leads to scorch. It is fairly well accepted that water movement in plants depends on a diffusion and water potential. By the cohesion theory, water is pulled up the stem in a continuous column, the driving force being in the soil and within the plant. Therefore, for transpiration and water movement to take place, hydrostatic pressure gradiants must exist along the trunk of the tree with pressures at the top being relatively more negative than those at the bottom and in the soil.

That is:



Over a number of site conditions and silviculture regimes, there will, in most instances, be considerable variation in the differences in hydrostatic pressure gradients due to differing soil properties, rainfall, stocking etc. Therefore, differences in soil, moisture contents and soil PH values will exist. This is why some stands suffer drought stress others are relatively healthy. This is why one drought index is not a satisfactory yardstick.

From the cohesion theory, the most sensitive above ground region of the tree would be the active growing tip, probably from the last two to three years growth, to the very top. It is this active region in which metabolites are concentrated. Thus, it is very likely (in fact, is the case) that drought stress conditions will be sensed in this region. Thus, if the RT (relative turgidity) of the needles in this region can be monitored, it will give a good idea of the moisture potential of the tree. However, we do not know what RT is a critical level. This will be determined by draughting a selection of young pines and by consulting any literature applicable.

Following on from this, it is necessary to relate RT with soil conditions. If a soil sample is taken within close proximity of a tree which has been folia sampled determine RT, we may be able to find a relationship between some soil property RT. For example, a soil MC% profile down to a depth of 60 cm. could be established. It is highly likely that a strong relationship exists between RT, soil MC% and PF.

PF

This is the scale used for a measure of the intensity with which water is held by the soil, i.e. the freedon of movement in soil water. The actula PF value is the log_{10} of the height of a column of water, measured in cm. which would exert the same suction as the soil sample - PF can be derived by the filter paper method.

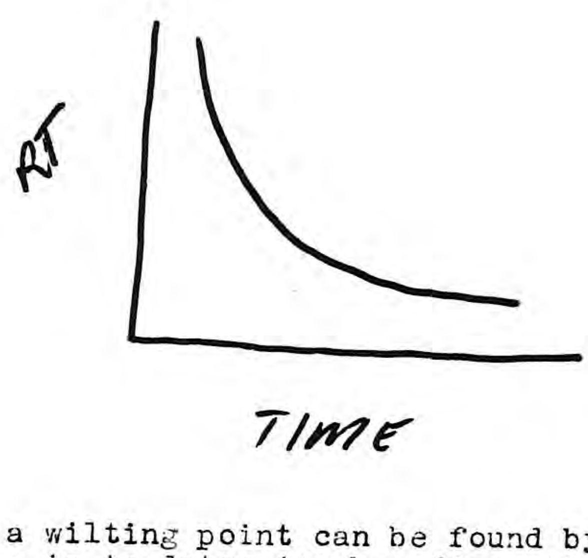
The next step is to find the RT, therefore the PF (or MC%) below which the tree would not survive, or below which it suffers in growth set-back. This can be done by;

(a) sampling sites currently under drought stress (during summer and autumn).

(b) collecting a number of young trees (3 - 4 years) and draughting them. This will enable us to measure RT until a stage when,

1. RT will level off,
2. plant dies,
3. both.

eg:



If a wilting point can be found by this method, then the next step is to determine how fire will affect the RT. The following is proposed.

Damage to the crown by fire would appear to be caused by hot air moving over the needles dehydrating them possibly causing

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chemical change. Flame height etc. are not necessarily importan What is important is the actual heating of the needles. This heat will be primarily a function of;

H = f (fine weather conditions, fuel type, amount, flammability)

These variables can be measured to some extent. Under a small (0.5 ha) experimental plot or under laboratory conditions, these could be monitored quite accurately. The problem is to monitor or measure the heat (H). This could be done quite accurately and pertenently will a number of thermometers, or time-thermometers around the various planes of the tree crown. This will give us a heat profile. A needle sample from the crown would be taken to determine RT before and after the fire, thus RT loss can be determined. We will probably obtain a moisture loss profile closely allied to both the heat profile and either soil MC% ir PF.

Thus, we may be able to predict what temperatures, therefore what fire variables, will result in a particular drying degree. Heat readings will be a reflection of fine weather, fuels, lighting techniques etc.

This proposal will have many "bug bears" so your comments would be appreciated.

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