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Proposed Working Plan - Research

1. Title of Investigation

Behaviour and effects of fire in P. radiata plantations.

2. Aim

To, by a number of stages, develope a reliable prescribed burning guide for P. radiata.

3. Principle

This investigation will try to relate the energy output of a fire as experienced in the green crown of the tree. Therefore the study will mean constructing energy profiles, that is, heat energy with height above the ground. The study will also attempt to relate heat energy with drying affect on crown needles. Each heat energy profile will be a result of fire variables such as fire weather, fuels, etc. and an attempt will be made to relate energy profilesaand ROS with these variables. Given an initial needle moisture deficit and a given energy profile an attempt will be made to determine the affect of the fire on the tree. This will be done by sampling following burning until the needle moisture deficit approaches the initial moisture deficit or until a plateau is reached. Closely monitored experimental fires will aid in relating fire energy output and fire variables.

4. Method

Stage 1: - Drying Factor.

This stage will try to determine a relationship between crown needle drying degree and heat energy. A numberof initial needle moisture deficits will be exposed to a number of heat energies and the drying factor measured. It would be desirable to measure the duration of temperature and relating this to drying of crown needles. However, such monitoring equipment is not readily available so a calorimeter is being used. The calorimeter is simply a test tube containing a know quantity of water and a thermometer.

Pilot trials - Laboratory trials have been run. These trials consist of:

a) Measuring the initial relative turgidity (RT) of a number of branches.

b) Immediately placing these branches into the kiln with a calorimeter. Care must be taken to ensure that branches and the calorimeter are in the same position in the kiln. An initial temperature reading of the calorimeter is taken. The kiln is set toaa temperature of approximately 90°C.

c) At various time intervals (approximately 2 minutes) each branch is sampled fornneedle RT (approximately 100 gm). The needles are sealed and immediately tested for moisture deficite. A calorimeter temperature reading is taken to determine heat energy in joules. This process is continued until the needles reach approximately 17% RT. Trials to date display (1) a strong relationship between drying and heat energy (as would be expected) (2) that more energy is needed to dry to 17% RT, those needles with a higher initial RT. (3) New flush needles are extremely susceptable and sensitive to heat and dry very rapidly, regardless of their initial RT.

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Tials in the Lewana plantation have shown that a relationship exists between average crown RT and soil, pF. This exercise consists of sampling crown needles of 14 year old P. radiata once a week to determine the RT and at the same time, determining the soil pF. This exercise has 2 purposes;

a) If a strong relationship between needle RT and soil pF can be shown to exist then by checking soil pF the needle moisture deficit can be predicted. This will, in conjunction with the earlier mentioned study, provide a guide as to the average susceptibility of the stand, to fires of particular energy output.

b) Will provide a drought index which may parallel the Byrom Drought index or the soil dryness index as developed in Tasmania. This index will serve as a burning guide and a drought stress guide.

Stage 2: - Energy profile and Tree Recovery.

This study will be a field study to construct an energy profile from ground level to a height % of 30m + if necessary. The study is also designed to monitor energy profile.

As fire behaviour is not a consideration in this study, fuel quantities etc, will not have to be measured and the study can be carried out on a very small scale. In fact, if is felt that one tree at a time can be studied.
This method will involve;

Selecting a healthy tree for study and taking an initial needle moisture deficit and soil pF. Calorimeters will be mounted up the tree and one metre away from stem. The calorimeters will be placed at 1m, 5m, 10m, 15m, and 25m above the ground. The calorimeters will be in the same plane. Immediately around the tree, an artificial fuel situation will be established. The fuel levels will be such to give a range of energy profiles over a number of studies. The area outside the fuel to be burnt will be cleared so the fire is contained within about a 5m radius of the study tree. After burning - that is, after the flames have died, the calorimeters will be retrieved and needle samples taken to determine the final needle moisture deficit. This exercise will be repeated (on different trees) until a range of energy profiles has been obtained. Broadly, the range will be from, no difference between final and initial needle moisture deficit to a final moisture deficit which will result in scorch and death to the upper portion of the green crown. The study will also include a number of different initial RT's so the recovery rate of the studies trees can be related to the drought index.

Stage 3: - Relating energy profiles to fire variables.

During the autumn-winter burning period, a number of experimental fires will be monitored. Calorimeters will be placed at various strategic positions within the burn at 1m above the ground. Most burning will be carried out in 12-14 year old P. radiata. Both needlebed and tops burns will be undertaken. Fuels will be measured and mapped according to the line transect method. Calorimeters will be placed in fuel areas ranging from very low fuel amounts to heavy fuel build up areas. All variables such as fire weather, fuel moisture content and bulk density will be measured as well as the initial needle moisture deficit of trees immediately surrounding the calorimeter. Flamesheight, ROS and the usual fire behaviour parameters will be measured. Fuels will be measured intensively - lines will be 10m apart. This will allow for fairly accurate

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quantity and bulk density mapping. With the calorimeters in a number of fuel quantity areas, a variety of fire behaviour and fire effects can be obtained from the one burn. It is hoped to relate fuel maps with heat energy outputs, thus crown drying and scorch. With sufficient data (including data from past pine fires) it is hoped that fire behaviour tables can be constructed which will predict ROS, heat energy output therefore a scorch or drying mosaic coupled with the fuel mosaic. That is, by mapping the fuels fairly accurately, one will be able to predict those areas susceptable to scorch and other degrees of damage or drying. It is also envisaged that the rate of recovery of a burned stand can be predicted and increment losses estimated.

Reports will be submitted with the completion of each stage.

Follow up work will deal with lighting techniques etc, as per red book.

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