## FIRE

**Foliar Moisture Trends During Bud Swelling and Needle Flush in British Columbia.**—Troublesome spring fires in British Columbia are not necessarily associated with lack of moisture in deep organic soil layers. At this time, when short-term drying conditions make it possible for surface fires to initiate and spread, fire control problems can be intensified by the low moisture content of conifer needles. These low foliar-moisture contents reinforce the ground fire potential and contribute to the ease of crowning when the fuel arrangement is favorable. Evidence (Gary, Rocky Mountain Forest and Range Experiment Station, Bot. Gaz. 132(4):327-332, 1971) suggests that the decline in 1-year-old spruce needle moisture content before flushing, and subsequent increase in moisture content, are primarily the result of temporary increase in dry weight of the needles which may amount to 30%. After flushing has taken place, the increase in relative moisture content of old needles becomes a matter of academic interest when compared with the much higher moisture contents of new needles and new leaves of associated undergrowth.

Previous studies have shown significant drops in the moisture content of 1-year-old conifer needles in Ontario (Van Wagner, Dep. For. Rural Develop., For. Br. Pub 1204, 1967) and in Alberta (Kiil and Grigel, Dep. Fish. For., Inform. Rep. A-X-24, 1969) during this period; and the suggestion has been made that low soil temperatures might cause water intake to be insufficient for the demands of transpiration at this time.

The sampling program herein reported was undertaken to (a) determine the magnitude of the effect with relatively warm unfrozen soil conditions, and (b) to demonstrate that altitudinal differences can be significant during this period.

Routine sampling of 1- and 2-year-old needles collected from a 10-year-old plantation near the Pacific Forest Research Centre was initiated in early February 1973. On each sampling afternoon, two 2-gram needle samples were collected from the 1- and 2-year-old branches of selected conifers. Each sample was a composite from locations around the lower third of the crown. The samples were weighed, oven-dried for approximately 20 hours at 100°C and then reweighed to determine the moisture content as a percentage of the oven-dry weight. Site differences combined with tree vigor and genetic variation between neighboring trees of the same species result in moisture differences of as much as 20%; but, within their respective time scales for flushing, all trees appear to exhibit the same seasonal trends.

Figure 1 shows the trend of needle moisture content and indicated date of flushing of the new needles. Table 1 compares

TABLE 1

The range in foliar moisture for one-year needles of several western and eastern Canadian tree species in spring and summer

| | Grand Fir | Western Hemlock | Douglas-fir | Norway spruce | Pine species | Balsam fir | White spruce |
|---|---|---|---|---|---|---|---|
| Max M.C. % | 176 | 156 | 142 | 106 | 125 | 113 | 115 |
| Min M.C. % | 127 | 110 | 96 | 77 | 99 | 89 | 84 |
| Range % | 49 | 46 | 46 | 29 | 26 | 24 | 31 |

Figure 1. Needle moisture traces for four western conifers.

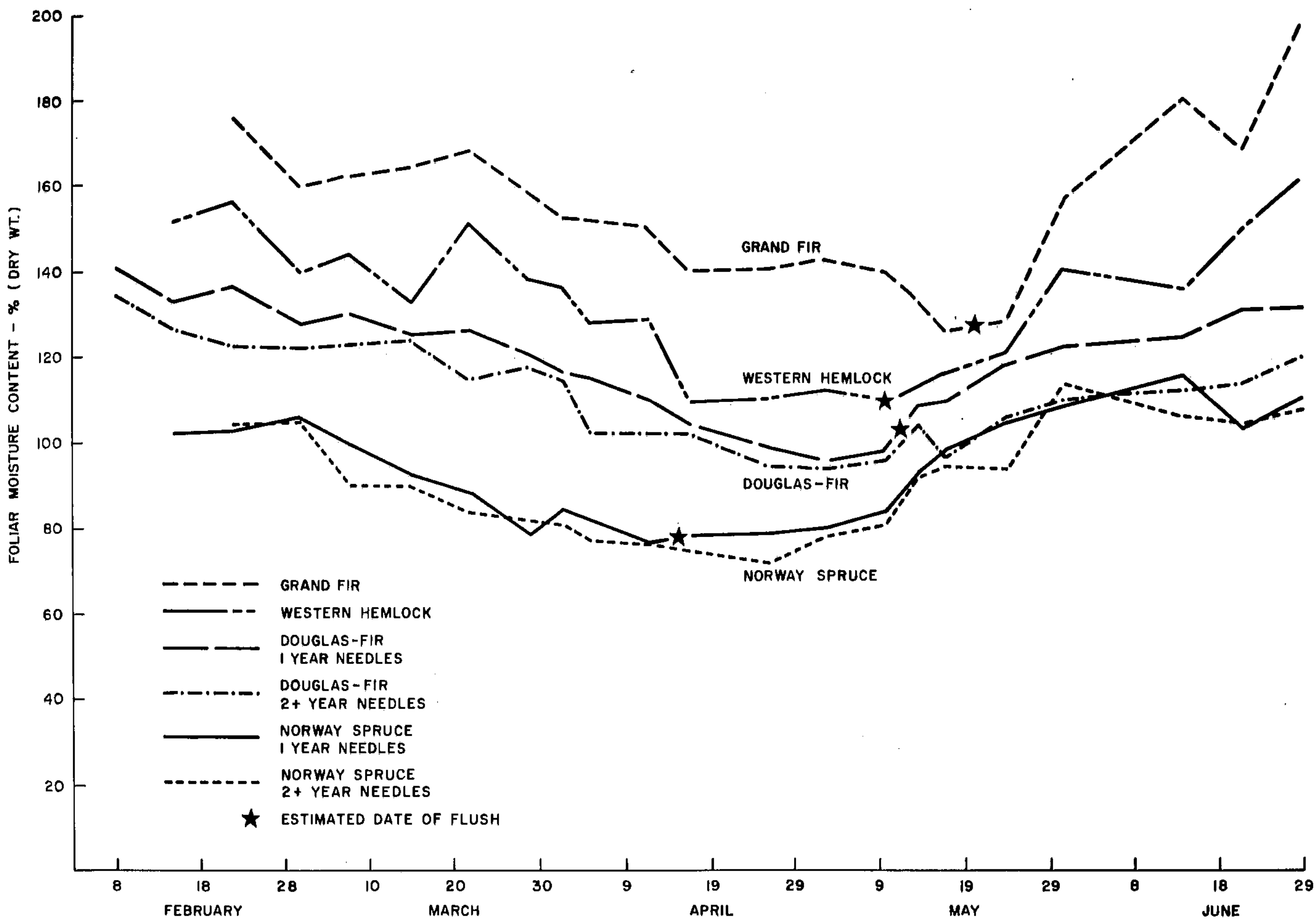
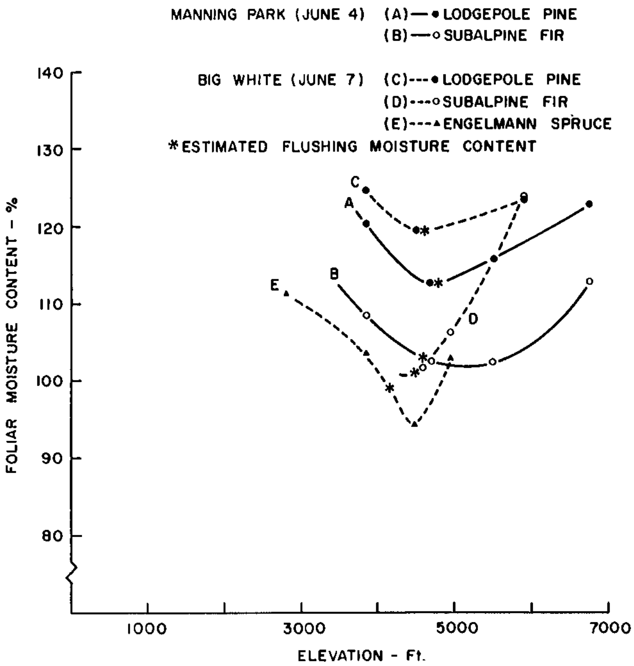


Figure 2. Needle moisture contents at varying elevations in the southern interior of British Columbia in early June.




the ranges of moisture content found in this study with those found by Van Wagner (loc. cit. table 4) in eastern Canada. The levels of moisture in all needles show a gradual decrease, reaching a minimum in late April to early May. These trends are similar to Van Wagner's, although the minimum moisture levels occur approximately 3 weeks earlier, coinciding with the time of flush for this region.

By using the same methods of collection as on the coast, additional needle samples were collected over a range of elevations near the Manning Park Lodge and Big White Mountain in the southern interior of British Columbia, on 4 June and 7 June 1973, respectively. Beginning at the highest possible elevation and sampling at approximately 500-foot intervals, decreasing foliar moisture levels were found down to the elevations where flushing was just being initiated (Fig. 2). The variation of moisture content with elevation on these two transects illustrates the existence of a zone of minimum foliar moisture content that would be expected to progress upwards as the season and state of flush advances. This progression is currently being investigated in the vicinity of Castlegar, B.C.

The existence of this zone of minimum foliar moisture, and its location at any given time, is a fuel factor which deserves recognition by fire managers.—R. N. Russell and J. A. Turner, Pacific Forest Research Centre, Victoria, B.C.

## FOREST PRODUCTS

**Purification of Tetrachlorophenol.**—Chlorinated phenols are among the most commonly used pesticides for the protection of manufactured products, including wood. There is a need to be able to produce individual chlorinated phenols and a number of methods are available for dichlorophenol, trichlorophenols (Milnes, Ger. Offen. 2060844, 14 pp., 1971; Renner and Stein, Ger. Offen. 2004985, 6 pp., 1971; Greco, W. J. Jr., Ger. Offen. 2121445, 12 pp., 1971; Sharov *et al.*, U.S.S.R. 326169, 1972) and pentachlorophenol (PCP) (Renckhoff and Steneberg, Ger. Offen. 1080565, 2 pp., 1960), but we have found no method of purification for tetrachlorophenol (TCP).

During experiments on the possible escape of PCP and TCP from heated TIMBOR solution (disodium tetraborate octahydrate) of a pH of 7.0 used to treat lumber against insect and fungal attack in service, it was observed that TCP has much higher volatility than PCP from this solution; therefore, the possibility of using steam distillation from buffered solution was tested as a means of TCP purification.

A solution (300 ml) of 100 g TIMBOR and 5 g technical TCP (containing about 16% PCP as impurity) was distilled, keeping its volume constant. Distillates in 25-ml fractions were collected. The amount of chlorinated phenols in these fractions was determined (Table 1) by gas chromatography (Cserjesi and Johnson, Can. J. Microbiol. 18:45-49, 1972).

TABLE 1

The amount of TCP and PCP in 25 ml fractions collected by distillation of technical TCP from a solution containing TIMBOR

| Fractions | TCP mg | PCP mg | Total mg | % TCP |
|---|---|---|---|---|
| 1st | 93 | 2 | 95 | 97.9 |
| 3rd | 115 | 3.5 | 118.5 | 97.1 |
| 5th | 116 | 3.5 | 119.5 | 96.8 |
| 7th | 80 | 3 | 83 | 96.4 |

In a following experiment, the first 100-ml fractions were collected from six distillations of TIMBOR solutions as described above to obtain higher purification. Redistillation of the collected 600-ml solution gave better than 99.6% pure TCP in the first 100 ml of distillate.

Raising of the pH to 8 by the addition of NaOH solution results in almost no PCP in the distillate, but with a low yield of TCP. Depending on requirements, an adjustment of the pH between 7 and 8, or redistillation, will produce TCP of higher purity than 97-98% if desired.—A. J. Cserjesi and E. L. Johnson, Western Forest Products Laboratory, Vancouver, B.C.

## MENSURATION

**A Simple and Quick Method to Assess Yearly Diameter Growth Response to Fertilization in Natural Forest Stands.**—The choice of models to evaluate the effect of different treatments on natural forest stands presents numerous problems in experimental design and in analysing results because it is difficult to find natural forest stands large enough to contain the numerous homogeneous sample plots required for a sound, conventional statistical analysis. Although plots are selected for their relative homogeneity, they nearly always differ either in number of trees, diameter class distribution, or stocking density. Also variations in growth rate for a given tree in a diameter class may mask the effect of various treatments over a short period of time.

To obtain the highest financial benefits, fertilization must take place about 10 years before harvesting when diameter increment is low. Because of this slow growth rate, often many years must elapse before diameter growth response to fertilization becomes evident when data are subjected to analysis of variance or covariance. With these techniques, acceptable results are obtained only after considerable time is spent adjusting the initial variation due to uncontrollable factors. Even then the error variance, although reduced, is not excluded. In fertilization experiments where annual measurements of the response to treatments are needed, analyses of variance or covariance fail because differences are slight and often masked by plot variability.

Whyte (personal communication, School of Forestry, University of Canterbury, Christchurch, New Zealand, 1974) sug-