The Role of Weather and Topography in the Development of *Dothistroma septosporum*.

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ABSTRACT

Dothistroma septosporum (Dorog.) Morelet is recognized worldwide as a foliar disease of pine trees, infecting needles and causing premature defoliation. This results in reduced growth of the tree and, in severe cases, death. Red banding, caused by the mycotoxin dothistromin, along needles where infection has been successful characterizes this fungal pathogen. In a severe outbreak of Dothistroma needle blight in the Skeena Stikine Forest District in northwestern British Columbia (BC), damage has ranged from low levels of infection to nearly 100% mortality. A high concentration of young susceptible hosts and the climate of warm, moist summers and cool, wet falls in this area are thought to be contributing to the outbreak. Heavy fogs generated in plantations close to rivers, lakes, or streams may also facilitate *D. septosporum* development. The purpose of this research is to identify climatic and site conditions contributing to the development of *D. septosporum* with respect to the severe outbreak happening in northwestern BC. The main objectives are to monitor the variation in disease expression, identify the ranges of temperature and humidity conducive to disease development, and identify site factors associated with disease.

In the Skeena Stikine Forest District four sites were selected according to signs of Dothistroma infection, accessibility, and the presence of trees within 10-25 years of age. Within each site, three plots were established for weekly monitoring. In each of the twelve plots, weather stations were set up and six trees were selected. Six plots also had leaf wetness sensors. On each tree, four cohorts of ten needles were marked. These needles were examined weekly for the development of red bands, fruiting bodies, and spore production. When fruiting bodies were detected, needles were extracted from the tree for dissection to determine their reproductive state. Survey data of lodgepole pine plantations in the Skeena Stikine Forest District was provided by the Ministry of Forests

and Range in Smithers, BC, and used to investigate topographic effects on disease development. Disease severity data from this survey was organized into categorical variables using 5%, 10%, 20%, and 50% functional live crown (FLC) thresholds.

Red bands and fruiting bodies were observed from early June to late September. The red color of *D. septosporum* bands fades over time and should not be used as a conclusive diagnostic feature, particularly in late summer. In four-day mixed effects models red banding development was significantly influenced by nightly minimum temperatures above 7^{o}C, nightly maximum temperatures above 18^{o}C, daily relative humidity above 70%, and daily leaf wetness above 40%. The same weather variables were significant in seven-day mixed effects models, except for nightly minimum temperatures which increased to above 10^{o}C. In four- and seven-day mixed effects models for fruiting body development, daily minimum temperatures above 6^{o}C and 7^{o}C, relative humidity above 90%, and leaf wetness above 30% had significant effects. Conidia were detected late June to late August, with production peaking in July. Ascospores were never detected in the field, but were present on dissected ascoma. Ascoma were detected only twice, suggesting that the sexual stage is rare in northwestern BC. No weather variables were correlated with conidia production due to insufficient data. Elevation was the only site factor retained in all binary logistic regression models; disease severity increased with lower elevation. Aspect was retained in models using 5% and 10% FLC thresholds; south-facing aspects discouraged disease severity. Slope and proximity to nearby lakes and rivers had no significant influence on disease severity. From these results a disease hazard rating approach was devised and maps were constructed to illustrate the predictive capability of the logistic regression models. In conclusion, when sufficient inoculum levels are present, low-lying areas where moist air can be retained for long periods facilitate *D. septosporum* development.