Author: Lance R. David, Information Technology eXperts, Inc., Fort Collins, Colorado

Blister Rust Extension to FVS Western Variants

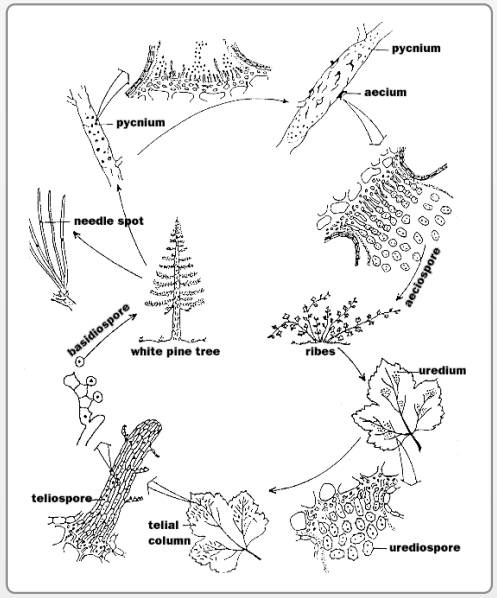
WHITE PINE BLISTER RUST MODEL

Background Information

The original model and base concepts were first developed as an independent model and the product of research by Geral I. McDonald, Raymond J. Hoff and William R. Wykoff (McDonald, Hoff, Wykoff, 1981). In the 1990s John Schwandt (FHP) and Geral McDonald spearheaded the first efforts to convert the existing computer model code to FORTRAN and make it compatible for linkage with the Forest Vegetation Simulator (FVS). The linkage with FVS was accomplished (by FTHET) and it was at this time that the first operational FVS model with Blister Rust extension was born. Field observation, data analysis, and some brainstorming led to incremental stages of model modification and enhancement during the following years. Now the Blister Rust model is at a point where it needs to be evaluated for its potential to address forest management needs beyond white pine blister rust in Northern Idaho.

We are interested in evaluating the Blister Rust Model's potential to characterize comandra blister rust (*Cronartium comandrae* Pk.) on lodgepole and ponderosa pine in the central Rocky Mountains. The Blister Rust Model has been linked to the FVS Central Rockies variant and is available. The Blister Rust Model has also been added to the Suppose interface to facilitate the evaluation process.

White Pine Blister Rust Life Cycle



Graphic from: http://dendrome.ucdavis.edu/wpbr/lifecyc.html

Primary Components of the Model

MODEL INITIALIZATION

Canker placement and count is accomplished with a canker list that places up to ten cankers on each tree by distance up and distance out for branch cankers and distance up and percent girdle for bole cankers. If not specified, canker placement is randomly generated by the model. Total canker count in addition to other pertinent parameters for individual tree records such as stock type and tree age is also entered through the canker list.

RUST INDEX

Rust Index (RI) (cankers / 1000 needles / year) is a measurement of a tree's or site's rust infection level and therefore susceptibility to additional blister rust infections.

RIBES

The three primary alternate hosts for *Cronartium ribicola* Fisch. specifically named in the model are: northern black currant (*Ribes hudsonianum*), prickly currant (*Ribes lacustre*), and sticky currant (*Ribes viscosisscimum*). It is hoped that these can be utilized as surrogates for alternate hosts of other rusts such as *Cronartium comandrae* Pk.

MANAGEMENT

Pruning and excising of cankers are management activities available in the Blister Rust Model. When a pruning activity occurs, the height to base of crown for each host tree is adjusted accordingly. The user may select "pathological pruning" in which case only branches with prunable cankers are removed from trees and the height to base of crown for these trees is not changed.

Ribes populations can also be managed, changing the spore production and likelihood of new infections on trees.

STOCK TYPE

Host tree species can be categorized into four stock types for purposes of representing different levels of rust resistance. Natural regeneration is assigned to wild stock type by default.

CANKER GROWTH RATES

Canker growth rates for branch and bole cankers are static values that can be changed by the user. The branch canker growth rate determines the speed at which a canker grows down the branch toward the bole. The bole canker growth rate defines the speed at which the canker encircles the bole. Although the bole canker growth rate is static, the rate that girdling occurs varies due to the dynamic diameter growth of the trees.

TOPKILL AND TREE KILL

When a canker sufficiently girdles the bole of a tree the portion of the tree above the canker dies. If at least 25% of the live crown remains below the canker, topkill is imposed on the tree but if girdling takes place and less than 25% of live crown remains, the tree is killed. This is not currently an adjustable parameter.

TREE STATUS TRACKING

Tree's blister rust status is reported by way of status codes based on the most lethal canker on the tree. The status codes in order of least to most severe are:

- NO = no cankers
- NL = non-lethal
- PR = prunable
- EX = excisable
- NS = non-salvable
- TK = top kill
- DD = tree died

PROGRESSION OF BLISTER RUST

The RI value defines the model progression and is a reflection of new infections and the rate at which successful new infections occur on trees. Geral McDonald (Intermountain Research Station, Moscow, ID) developed several methods to control the progression of blister rust. Within the model there is a stand age Gaussian function which provides a normal curve around peak age and enables the user to define the shape of the curve controlling the number of new infections throughout the duration of the simulation. A stand age log function provides a skewed curve around peak age allowing more early infections. A static RI can be used which holds the number of new infections at a relative steady rate. The remaining option is to calculate RI from basal area which causes the number of new infections to fluctuate in response to change in basal area. The RI calculation based on basal area is actually a three step process. First, the proportion of full sun reaching the ground is calculated from basal area. Then ribes populations are determined from the proportion full sun value. Finally, the RI is calculated based on the ribes populations.

Poster Design & Layout: Sheryl A. Romero, ITX, Inc., Fort Collins, CO

Photographs from: http://www.forestryimages.org/