

DOUGLAS-FIR PROGENY TESTING FOR RESISTANCE TO
WESTERN SPRUCE BUDWORM

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Ample evidence exists that inland populations of Douglas-fir suffer varying amounts of defoliation by western spruce budworm (Johnson and Denton 1975; Williams 1967; McDonald 1981). Such variation in plant insect association can be the result of the plant escaping attack in time and place to actual confrontation between plant and insect (Harris 1980). Co-evolved genetic interaction between insect and plant is usually involved in initiation and preservation of plant polymorphisms, whether they be morphological or chemical responses (Gilbert 1982; Berenbaum 1983). Since western spruce budworm (*Choristoneura occidentalis* Freeman) is a native insect, there are three reasons for wanting to know more about the genetic nature of the Douglas-fir-budworm interaction. First, genetic interaction may hold the key to understanding budworm population release and crash (Lorimer 1982). Second, a co-evolved and dynamically balanced genetic interaction may be keeping damage to levels biologically tolerable to Douglas-fir, which, if preserved, will provide the foundation for additional silvicultural and chemical controls (Browning 1980). The third reason is the possibility of actively breeding for unnatural levels of resistance for use in reforestation (Lamb and Aldwinckle 1980).

All investigations of genetics must begin with some observable difference in the target populations. Budworm feeding differences are readily apparent in western conifer populations (Williams 1967; McDonald 1981). These differences could be caused by factors ranging from asynchronous phenology (Manley and Fowler 1969) to a complex interaction of pheromones, mating, egg oviposition, and larval feeding preference (McDonald 1981). The first step to unlocking these secrets is progeny testing (McDonald 1982). Such tests have shown the presence of independent genetic components for larval feeding (family heritability = 0.43) and oviposition levels (stand differences) on 2-year-old Douglas-fir (McDonald, in press). One must conclude that some level of genetic interaction for one or both of these traits is functioning. More importantly, these traits may be reciprocally related to geographic variation of budworm populations as delineated by Willhite and Stock (1983) and discussed by

McDonald (in press). Such geographic association could materially change seed and breeding zone requirements for inland Douglas-fir.

Since ecological adaptation has a genetic basis in Douglas-fir (Rehfeldt 1979), genotypes were expected to express consistent long-term growth patterns in response to their adapted environments. Patterns of radial stem growth were studied and found to be associated with a tree's ability to accommodate budworm outbreaks. The patterns of radial growth of dead or heavily defoliated Douglas-fir varied greatly, whereas paired, non-defoliated trees showed much more consistent growth patterns from year to year.

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