SEED SHORTFALL IN LODGEPOLE PINE

Samples for histological study were collected from a seed orchard located at Kalamalka Research Station, Vernon, BC. Weekly sample collections were completed between mid-July and mid-September, 2012. A big increase in damaged seed was confirmed during August. The percentage of filled seed per cone (FSPC) diminished progressively over the course of the first two weeks, reaching levels of under 50% FSPC, where it stayed until mid-September. Under a dissecting microscope, seed death occurred in two steps: death of the megagametophyte was followed by that of the embryo. Dying tissues ranged in colour from yellowish-brown to dark brown. Both gametophyte and sporophyte, i.e., embryo, were soft in texture, unlike their healthy counterparts, which were not only firm, but of much lighter hue.

Histological analysis revealed tissue degeneration in the seed. Healthy tissue was composed of storage cells that had abundant reserves of protein bodies, starch grains, and lipid bodies. The cells were tightly appressed to one another. Tissue degeneration was categorized as three types: Type I began with the appearance of tiny intercellular spaces. These spaces increased gradually in size and then the tissue developed large holes. Fungal hyphae were frequently observed in cells as well as intercellular spaces. Type II degeneration had the appearance of cell liquidization. Cell walls were dissolved and cell contents were amorphously coagulated. Yellow particulate structures were frequently observed. Type III was progressive loss of cell contents until only cell walls remained. Protein body breakdown was followed by vacuolation and nuclear disintegration. Tissue integrity failed with cells showing signs of cytoplasmic collapse and cell wall rupture. Types I and II occurred randomly at multiple loci in a megagametophyte. Different stages of Type I degeneration were sometimes present in the same tissue. Types I and II were found in samples from all collection dates, whereas Type III was observed in all dying megagametophytes that had softened tissue.

Our histological study does not support the possibility of *Leptoglossus occidentalis*-related seed loss. However, our study did not exclude the possibility of other organisms that might contribute to seed loss. The presence of yellow particles found in many of the samples suggests the presence of an unidentified organism or an unknown aggregation phenomenon. A major reason for degeneration in seed was the presence of a fungus. Hyphae were widespread in holes that developed in the degenerating megagametophyte in many of the samples. In conclusion, seed shortfall in lodgepole pine shows a progressive degeneration of the seed and there are different types of tissue degeneration which can occur in the absence or presence of a fungus and/or some unidentified particles implying that there is more than one biotic or abiotic factor responsible for seed death. High temperatures in August may accelerate the process of seed degeneration.

Lisheng Kong and Patrick von Aderkas
Centre of Forest Biology
Department of Biology
University of Victoria
Victoria, BC
E-mail: lkong@uvic.ca