

The cumulative effect hypothesis involving effective freeze-thaw damage and molecular mechanism of cold resistance in poplar

Cheng-Chao Yang

(Liaoning Provincial Institute of Poplar, Gaizhou 115213, China)

Abstract: Since 2000, poplar in Liaoning Province of northeastern China has suffered five serious overwintering injuries, resulting in huge economic and ecological losses. On the basis of elucidating the mechanism of overwintering damage of poplar and proposing the hypothesis of the cumulative effect of effective freeze-thaw damage, the effective freeze-thaw damage threshold of fast-growing poplar was determined, and the theoretical model of effective freeze-thaw damage was constructed and applied in the risk assessment of overwintering damage of poplar. Transcriptomic studies on freeze-thaw stress in poplar were carried out to screen differentially expressed LncRNA and perform qRT-PCR analysis, so as to elucidate the molecular mechanism of cold resistance in poplar. The comparative experiment included (1) the effective freeze-thaw cycle causes irreversible damage to the poplar, and when the cumulative damage exceeds the freeze-thaw resistance, the poplar dies. (2) the minimum required days of frost free period for fast-growing poplar of Sect. *Aigeiros* were 170 d. During the cold resistance exercise period and off exercise period, when the daily minimum temperature was $\leq -3\text{ }^{\circ}\text{C}$, the daily maximum temperature was $> 0\text{ }^{\circ}\text{C}$ and the daily range was $\geq 12\text{ }^{\circ}\text{C}$, the fast-growing poplar of Sect. *Aigeiros* will have effective freeze-thaw injury. The greater the effective freeze-thaw injury risk index (Rio) was, the greater the risk of overwintering injury was. The model was applied to draw the overwintering injury risk assessment map of fast-growing poplar of Sect. *Aigeiros* in Liaoning Province. (3) key gene mining and pathway analysis of poplar response to low temperature stress were conducted, and glucan endo-1,3-beta-glucosidase and UDP-glucuronosyltransferase genes were screened out in starch-sucrose metabolism pathway and pentose and glucuronate interconversions. It is closely related to cold resistance. The model has great practical value. The development of EFTI model of poplar lays a foundation for preventing and reducing overwintering injury of poplar in Liaoning Province and other provinces. It is suggested to focus on the molecular mechanism of reversible freezing and thawing damage repair of poplar, so as to provide technical support for cold resistance breeding of poplar.