

Stubble and Senesced Leaves Are the Primary Sites of Ice Nucleation Activity in Wheat

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Abstract : Economic loss to frost damage is increasing over the past years in the Western Australian Wheatbelt. Agronomic, genetic, and climatic works have still found a weak correlation between temperature and frost damage. One possibility that has not been explored within the Australian cropping system is whether ice nucleation active bacteria (INB) either present in situ on crop residue or introduced by rainfall could be responsible for the increased sensitivity of cereal plants to frost at different stages of development. This study investigated upper and lower leaf canopy, stubble, and soil as a potential site of ice nucleation activity (INA) and tracked the changes in INA during the plant development. We found that older leaves of wheat are the primary sites of ice nucleation (-4.7 to -6.3°C) followed by stubble (-5.7 to -6.7°C) which increases the risk of frost damage during heading and flowering (the most susceptible stages). However, healthy and green upper canopy leaves (flag and flag-2) and the soil have lower INA (< -11°C) during the frost-sensitive stage of wheat. We anticipate the higher INA on the stubble and older leaves to be due to the presence of biologically active ice-nucleating bacteria (INB), known to cause frost injury to sensitive plants at -5°C. Stubble retained or applied during the growing season further exacerbates additional frost risk by potentially increasing the INB load. The implications of the result for stubble and frost risk management in a frost-prone landscape will be discussed.

Keywords : frost, ice-nucleation-activity, stubble, wheat

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