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The Role of Seed Structure and Oxygen Responsiveness in Pre-Germination Flooding Tolerance of Soybean Cultivars

Xiao-Hai Tian[1)], Teiji Nakamura[2)] and Makie Kokubun[2)]

1) Agronomy Faculty of Yangtze University
2) Graduate School of Agricultural Science, Tohoku University

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Abstract: Flooding during germination often inhibits the germination and emergence of soybean [*Glycine max* (L.) Merr.], but little is known about the mechanisms involved in the tolerance of soybean cultivars to the damage caused by the flooding. The objectives of this study were to characterize the germination responses of soybean cultivars to pre-germination flooding and low oxygen conditions, and to identify possible seed traits responsible for the tolerance. A comparison of germination percentages among 18 cultivars under optimal and flooding conditions for 3 d enabled the identification of two tolerant cultivars (Williams and Peking), and two susceptible cultivars (Nakasennari and Enrei), which were used for further analyses. A comparison of the water absorption speed (WAS) in the following seed forms: embryo only (E), embryo with aleurone layer (E + AL), and intact seed with aleurone layer and seed coat (E + AL + SC) revealed that the aleurone layer provides a barrier to water penetration during the first hour of inundation regardless of cultivar. The intact seeds of a tolerant cultivar, Peking absorbed water more slowly than the other cultivars in the first hour of flooding. When the oxygen concentration in the seed container was reduced to 70 mL L^{-1} for 3 d, the germination percentage of susceptible cultivars was reduced to approximately 70 % whereas that of tolerant cultivars remained high, indicating that responsiveness to low oxygen could also be responsible for pre-germination flooding tolerance of soybean cultivars.

Keywords: Aleurone layer, Flooding tolerance, Germination, Low oxygen, Seed

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