ID: 564

Comparative Aluminum Stress Tolerance in Red (Fırat-87) and Black-Seeded (Beluga) Lentils

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Abstract

Aluminum (Al) is a significant toxicant that restricts root growth in plants, even at low concentrations found in acidic soils. This study aimed to investigate the comparative Al stress tolerance of a red lentil cultivar (Fırat-87) and a black-seeded lentil cultivar (Black Beluga). Five-day-old seedlings of both cultivars were exposed to 100 µM $CaCl_2$ (control) or 100 µM $CaCl_2$ supplemented with 50 µM Al (Al treatment) under hydroponic conditions at pH 4.5 for 24 hours. Histochemical staining of Fırat-87 roots with hematoxylin demonstrated clear cracks and intense dark staining in the root apex and elongation zone, indicating a greater accumulation of Al compared to Black Beluga. Similarly, Evan's blue staining revealed cracks and dark blue staining in the root elongation zone of Fırat-87, whereas Black Beluga showed no visible cracks or dark staining. Lipid peroxidation, assessed using Schiff's reagent, exhibited pronounced dark pink staining in the root apex of Fırat-87, but only minimal staining in Black Beluga. These histochemical analyses suggest that Fırat-87 is more susceptible to Al toxicity than Black Beluga. Consistent with these findings, Black Beluga exhibited significantly higher relative root elongation (77.27%) compared to Fırat-87 (55.32%), reinforcing its Al tolerance. Quantitative real-time PCR analysis of the *LcALMT1* gene revealed significantly higher expression levels in Al-treated roots of Black Beluga compared to Fırat-87, implying that *LcALMT1* may play a crucial role in the enhanced Al tolerance observed in Black Beluga. In conclusion, these results demonstrate that Black Beluga is an Al-tolerant lentil cultivar, making it a promising candidate for cultivation in acidic soils without compromising seedling establishment and subsequent growth.

Key Words: *Aluminum toxicity, Lentil tolerance, Histochemical staining, Root elongation, LcALMT1 gene expression*