



## EFFECTS OF ALUMINUM ON NUCLEOLI IN ROOT TIP CELLS, ROOT GROWTH AND THE ANTIOXIDANT DEFENSE SYSTEM IN *VICIA FABA* L.

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The effects of different concentrations of Al (10  $\mu$ M, 50  $\mu$ M, 100  $\mu$ M) on nucleoli in root tip cells, root growth, antioxidant enzyme activity and malondialdehyde (MDA) content were investigated in hydroponically grown *Vicia faba* L. Aluminum significantly inhibited root growth of *V. faba* treated with 50  $\mu$ M and 100  $\mu$ M Al. In the nucleolus in root tip cells, some particulates containing argyrophilic proteins were extruded from the nucleus into the cytoplasm, and some were scattered in the nucleus after Al stress. Superoxide dismutase (SOD) activity in leaves and roots exposed to different concentrations of Al was mostly higher than in the control. Seedlings exposed to 100  $\mu$ M Al showed significantly higher peroxidase (POD) activity in roots than in the control. POD activity increased much more in roots than in leaves. Catalase (CAT) activity was lower in roots than in leaves. Malondialdehyde (MDA) content in leaves and roots of plants exposed to 50  $\mu$ M and 100  $\mu$ M Al was significantly higher than in the other groups and the control at 6 to 9 days of treatment. These results suggest that alterations in nucleoli and altered antioxidant enzyme activity and MDA content in *V. faba* can serve as useful biomarkers for detection of Al toxicity. The mechanisms of Al toxicity and tolerance in *V. faba* are briefly discussed.

**Key words:** *Vicia faba* L., nucleoli, aluminum (Al), antioxidant enzymes, malondialdehyde.

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