Nitrogen (N) constitutes approximately 2% of plant dry matter, and is an essential component of many key macromolecules, such as proteins, nucleic acids, and chlorophylls. N availability in soil is considered to be one of the major limiting factors for plant growth. Although the high N requirements of crop plants can only be met by the application of fertilizers, fertilization represents the greatest cost of agriculture production. Most plants acquire inorganic N from soil in the form of nitrate (NO_3^-) and/or ammonium (NH_4^+). On a global scale, crops are supplied by several dozen metric tons of fertilizers annually; however, plants use less than 50% of applied fertilizers, mainly because of nitrate leaching. Excessive nitrate application can have detrimental effects, such as the eutrophication of water tanks and the contamination of ground water. Additionally, while most plant species can tolerate high nitrate concentration (mainly stored in vacuoles) without any toxicity, however nitrate causes dangerous diseases in the humans and animals that consume these plants. To increase the efficiency of agricultural systems and to protect the environment and human health, the application of ammonium is a desirable alternative (ammonium is not leached from soil and is not accumulated in plants). Ammonium assimilation by plants requires 5-fold less energy than nitrate assimilation, and although it could be assumed that the most favourable form of N for plants is ammonium, surprisingly, the use of ammonium causes severely slowed growth in many agriculturally important plant species (the so-called ‘ammonium syndrome’). Research on the mechanisms of ammonium toxicity has led to numerous hypotheses. It has been suggested that the modification of hormone homeostasis, pH imbalance, root carbohydrate limitation, or an energy deficit could be the underlying reasons for ammonium syndrome; however, most of these hypotheses have been tested and subsequently rejected. Thus, despite decades of research in this area, the detailed mechanism underlying the sensitivity of plants to ammonium is still unclear. The results of our research have shown that long-term ammonium nutrition is associated with imbalances in the cellular oxidation-reduction state, the increased formation of reactive oxygen species (ROS), the impairment of cellular components, and modifications in the functioning of the mitochondrial electron transport chain. Our most recent data also indicate that treatment with ammonium led to an ionic imbalance, most notably causing a deficiency in the levels of calcium in the shoot. Calcium is an essential macronutrient that plays an important role in the functioning and structure of plant cells. Thus, the aim of the project is to elucidate whether changes in the metabolism/cellular localization of calcium is the major determinant of symptoms of ammonium syndrome. The project will investigate the calcium metabolism of wild-type and mutant lines, in the plant model organism *Arabidopsis*, in response to ammonium nutrition. In wild-type *Arabidopsis*, we aim to determine the content and intra-/extra- cellular localization of calcium in different organs, and the physiological availability of calcium. Furthermore, changes in the localization and root-to-shoot transport of calcium under conditions of ammonium nutrition will be forced using *Arabidopsis* mutants. The proposed study will contribute to the understanding of the mechanisms of ammonium toxicity in plants.