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THE UPTAKE AND REDISTRIBUTION OF NUTRIENTS IN PLANTS

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In addition to carbon, hydrogen and oxygen, plants require adequate amounts of at least 14 mineral elements for their nutrition. These include the macronutrients nitrogen (N), phosphorus (P), potassium (K), calcium, magnesium and sulphur, and the micronutrients chlorine, boron, iron, manganese, copper, zinc, nickel and molybdenum. Most of our recent knowledge concerning their uptake by roots and redistribution within plants has focused on the molecular biology of transport proteins, their locations and functions, and the regulation of their abundance and activities in response to nutrient deficiencies. Transport proteins are required to facilitate the movement of mineral nutrients, whether as ions, chelates or organic compounds, across membranes. Three general categories of transport proteins are recognised: (1) Primary active transporters (pumps) that are directly dependent upon the hydrolysis of energy substrates such as ATP and pyrophosphate. (2) Secondary active transporters or 'coupled transporters' that harness the electrochemical gradient of a driving ion, which is generally the proton (H^+) in plants, to the movement of another ion in either the same (symport) or opposite (antiport) direction. (3) Passive transporters that catalyse the movement of solutes down their electrochemical gradient, which include carriers (uniporters) and channels. Often these transport protein have a high specificity to allow the accumulation of nutrients and the exclusion of toxic solutes from metabolic compartments. The specificity of transport proteins allows the mineral composition (ionome) of plant tissues, cell types and subcellular compartments to be controlled. It is unsurprising, therefore, that (1) about 5% of all genes encoding proteins encode transport proteins, (2) many genes (and gene families), expressed in different tissues or present on different membranes, are responsible for the uptake and movement of individual nutrients, and (3) the complement and activities of transport proteins on particular membranes are precisely controlled. In this talk I will describe the genes encoding transport proteins facilitating the uptake and distribution of N, P and K in plants, the tissue and cellular locations of the proteins they encode, the role of these proteins in plant physiology, and the regulation of their abundance in response to mineral deficiency.

Key-words: fertiliser, nitrogen, phosphorus, potassium, plant mineral nutrition.

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