STARCH DEGRADATION PATHWAYS IN PLANTS

Summary

Starch is the main storage material in higher plants. It is accumulated both in chloroplasts (transitory starch) and in non-photosynthetic tissues (storage starch), in the form of starch granules composed of amylose and amylopectin. Transitory starch accumulated during the day is almost completely degraded at night, when it serves as the main source of energy for the cell metabolism. The biochemical pathway of starch degradation in chloroplasts has been fully characterized only in *Arabidopsis thaliana*. This process can be divided into two steps: the release of soluble glucans from the granule by α–amylase and further degradation of these glucans by β–amylase and de-branching enzymes. The main product of this degradation pathway is β–maltose, which is afterwards metabolized in the cytosol. The degradation of transitory starch is a periodic process, regulated by the circadian clock, starch phosphorylation and enzyme activity. Storage starch is accumulated for longer periods of time in non-photosynthetic parts of the plant such as cereal and legume seeds, roots, tubers or rhizomes. In these organs the enzymatic reactions, which lead to storage starch degradation and their regulation are different than in the case of transitory starch, and they vary significantly between species. An interesting pathway of starch degradation control, unknown in other species, has been discovered in the duckweed *Spirodela polyrhiza*. At the end of the vegetative season this water plant forms turions – resting fronds which sink to the bottom of ponds and lakes, and germinate when conditions become favorable. Turions contain starch as a storage material which helps them survive the period of dormancy and, during germination, provide energy for growth of new fronds. Both germination of turions and starch degradation are induced by light and controlled by phytochrome B. The germination response to light is mediated by a low fluence response (LFR), whereas starch degradation can be controlled by a red light–dependent low fluence response or a far red–dependent high irradiance response (HIR). The processes of germination and starch degradation, although independently controlled, are closely connected. Response to a starch degradation–inducing signal is possible only under condition that germination is sufficiently advanced and the new sprout is ready to receive the degradation products. If this is not the case the light–induced signal can be stored until the sprout is formed.