

Plants use light as a primary source of energy, but light gives also precious information about the environment. Being sessile, plants cannot escape when they experience harsh conditions, including light excess or deficiency. Plants respond to adverse light conditions through several physiological reactions, aimed at mitigating their negative effects. Thus, they developed a set of protein light sensors, called photoreceptors, to perceive the light quality and quantity. Chloroplasts are the main factories of plant cells, where organic compounds are produced from carbon dioxide and water in a process called photosynthesis. Several mechanisms evolved to optimize the photosynthetic efficiency of plants, including chloroplast movements within the cells. In low light chloroplasts gather at cell walls lying perpendicular to the direction of incident light. This reaction is called chloroplast accumulation and is aimed at increasing light capture in conditions of limited light. In strong light, chloroplasts gather at cell walls lying parallel to the direction of incident light. This response is called chloroplast avoidance and serves as a photoprotective mechanism against damage to the photosynthetic apparatus. In land plants chloroplast movements are controlled by phototropins, which perceive blue light and ultraviolet radiation. Phototropin2 can change their signalling activity between chloroplast accumulation and avoidance depending on light intensity and also positions chloroplasts in the dark. However, it is not known how phototropin triggers these three different responses in one cell.

The aim of this project is to understand the link between phototropin photosensitivity and the direction of chloroplast movements: towards or away from light. Structural studies will be performed to investigate the conformations of phototropins in light and dark conditions. By using modified phototropin versions characterized by altered light photosensitivity, the relationship between the time of photoreceptor activation and the triggered chloroplast response will be investigated. Factors important for chloroplast positioning in the dark will be also analysed.

Chloroplast movements are important physiological responses of plants, however many questions about the signalling pathway from the photoreceptor remain unresolved. This project is aimed at the identification of the molecular factors important from switching the phot2 signalling pathway between chloroplast accumulation and avoidance.