

our observations, we conclude that carotenoids and MAA, that both showed the highest absorbance spectrum, might be the main compounds that render protection in cells of this species to high light UVR. Furthermore, MAAs has also been shown to act as a screen (at 320 nm) in several species of blue–green algae, reducing the effects of UV-B radiation.

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C3.15

Genome-wide analysis of transcriptional changes in response to drought stress in growing leaves of rice

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Drought is one of the primary constraints of crop productivity. Improving the efficiency of water usage and the tolerance for growth under conditions of sub-optimal water have a profound impact on rice production. Therefore the aim of this work is to understand how drought affects the growth of the rice plant. At the cellular level plant growth is a result of only two processes: cell division and expansion. Through a kinematic analysis of *Oryza sativa* ssp. *japonica* grown under control and drought conditions, we show that a 50% reduction in leaf-elongation rate occurs due to a 15% reduction in mature cell size and, more importantly, a 40% reduction of cell production rate, which in turn is caused by a 35% smaller meristem and 23% slower rates of cell division. Flow-cytometry showed that the inhibition of the cell cycle occurs predominantly at the G1/S transition. We therefore determined the kinase activity associated with the three A-type CDKs, encoded in the rice genome, which was strongly reduced in response to drought rather than its protein level. By means of genome-wide microarray analysis we further deciphered the transcriptional changes occurring in the meristem and mature regions of the drought leaves in comparison to the well watered control. These data provide a first detailed insight of molecular regulation of the growth response to drought conditions in rice leaves, providing a basis to develop strategies to enhance drought tolerance and yield of this important crop species.

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Cryoprotectants are metabolic fuels during long term frost exposure in the earthworm *Dendrobaena octaedra*

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Ectothermic animals that live in the subarctic and temperate regions must have strategies to deal with periods of frost during winter. The earthworm *Dendrobaena octaedra* is a freeze tolerant species that accumulates large concentrations of the cryoprotectant glucose upon ice formation in the extracellular fluid. This study investigates if *D. octaedra* metabolizes its primary cryoprotectant as an energy source when frozen for longer periods. In this study *D. octaedra* were exposed to frost at $-2\text{ }^{\circ}\text{C}$ for 47 days. The results clearly demonstrate a gradual decrease in the level of glucose and simultaneously an accumulation of lactate, alanine and succinate as a result of the continuous anaerobic metabolism. Freeze mortality ($\sim 30\%$) did not

increase with time suggesting that the accumulation of waste products were not toxic to the worms. Instead dead worms were always characterised by low glucose and glycogen levels indicating that depletion of fermentable resources was the primary cause of death. Calorimetric measurements of metabolic rate showed a 15-fold metabolic depression in frozen versus unfrozen worms and this reduction in metabolic rate is clearly of importance for long term survival of frozen worms. On the basis of metabolic rate measurements we calculated that the “average” worms would be able to survive for a total of 83 days before the glucose storage becomes exhausted. In conclusion, the present study suggests that the large accumulations of glucose during frost may be more important as an anaerobic fuel source than as a cryoprotectant.

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Pretreatment by high temperature increased tolerance of tomato plants to fusarium wilt

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The mechanisms of tomato plants adaptation to high temperature and to pathogens attack were studied. High temperature treatment of 4-months-old tomato plants included daily 3 h heating of plants in growth room under $40\text{ }^{\circ}\text{C}$, $110\text{ }\mu\text{mol quanta m}^{-2}\text{ s}^{-1}$ and 60–70% humidity. Pathogens (*Fusarium oxysporum*) were inoculated in tomato plants through root system. High temperature inhibited partially the photosynthesis and respiration in first days of treatment. Physiological functions were renewed daily after stopping of stress impact. High temperature effect was decreasing in the course of treatment. Considerable differences between control and heated plants were absent after 5 days of treatment. Subsequent *Fusarium oxysporum* inoculation caused different pathogenesis route. In previous untreated plants, the fungi were proliferated actively in root tissues and mycelium was enlarged and corked the phloem. The decrease of xylem flow and dehydration of plant tissue were displayed in this case. The activation of destructive processes (lipid peroxidation and generation of reactive oxygen) was obtained. Photosynthesis and respiration under fusarium wilt were suppressed. In previous heat treated plants, pathogenesis proceeded slowly and benignly. In these plants protective system (lectine and anthocyan accumulation) were activated. The mechanisms of cross-adaptation between biotic (fungi) and abiotic (high temperature) stress are discussed.

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Environmental tolerances of Gammarid amphipods: Lessons from myosin heavy chain genes

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The tolerances of marine Gammarid amphipods to environmental stress can vary from subtidal species that experience fairly stable