

D-D3-07

Photosynthetic rate, stomatal conductance and transpiration rate of rapeseed plants in response to waterlogging and recovery

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Rapeseed is one of major bio-diesel source in the world. The growing area of rapeseed is expanding rapidly in the cereal-growing areas after the rice harvest. Global warming causes greater than normal rainfall during vegetative stages and also causes waterlogging for several days. The objective of this experiment was to investigate the impact of short-term waterlogging and to recover from waterlogging of the root system associated with photosynthetic rate, stomatal conductance and transpiration rate. Three-month-old seedlings (*Brassica napus* L. cv. 'Young-San') were flooded by placing their pots inside larger plastic pots filled with tap water with a 2-cm water layer over soil surface. For recovery purpose, the pots containing waterlogging treated plants were removed from the water, drained and treated as control plants. Up to 6 days after waterlogging treatment, photosynthetic rates of waterlogged treated plants were significantly less than those of control plants. Waterlogged treated plants significantly reduced stomatal conductance and transpiration rate from 3 days after treatment. These results suggest that the longer the duration of waterlogging, the more damaging the effect. During recovery period, net photosynthetic rate, stomatal conductance and transpiration rate are currently undertaken and data will be presented.

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D-D3-08

Overexpression of AtHMA3 enhanced Cd and Pb resistance.

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HMA3 is an *Arabidopsis thaliana* P_{1B}-ATPase which transports Cd and Pb in the plant cell. To test whether AtHMA3 can be used to develop plant with enhanced resistance to Cd and Pb for phytoremediation, we overexpressed AtHMA3 in Columbia-0 using a pBI121vector containing the 35S promoter. Seven lines of transgenic plant were obtained from selection on kanamycin. AtHMA3 transcript levels determined by RT-PCR were higher in overline plants than in wild-types. To evaluate the resistance of the transformants to heavy metals, seeds of wild type plant and AtHMA3 overlines were germinated and grown on agar plates containing 50µM Cd or 0.5mM Pb for 3 weeks. In the control medium without heavy metal, the growth of wild-type plants and overlines was similar. Some overlines, however, grew better than wild type plants about 1.2-to 2.0-fold in Cd or Pb containing mediums. The difference in fresh weight varied among the overlines and ranged from 1.8-to 2.1-fold of wild type in Cd-containing medium, and 1.3-to 4.0-fold wild type in Pb-containing medium. In addition to their leaves were broader and longer than those of the wild-types. Chlorophyll contents were not significant difference between overlines and wild-types. These results show that HMA3 contributes to Cd and Pb resistance, and that it might be useful for the phytoremediation.

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