Apoplastic responses to elevated manganese supply in barley (*Hordeum vulgare*) and rice (*Oryza sativa*)

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Introduction: Previous studies on manganese (Mn) toxicity in cowpea (*Vigna unguiculata*) reveald the decisive role of the leaf apoplast for the development or avoidance of Mn toxicity (Fecht-Christoffers et al., 2003, 2006, 2007). Brown spots are also a typical symptom of manganese toxicity in monocots, especially in barley (Williams et Vlamis, 1957). Barley is sensitive to excess Mn (Duke 1983) while rice is able to tolerate high concentrations of manganese in the plant tissue (Foy et al., 1978, Nelson, 1983). This study focuses on the role of the leaf apoplast in Mn sensitivity in the Mn-sensitive monocot barley or Mn-tolerance in the extreme Mn tolerant monocot rice.

Material and methods: Barley and rice plants were hydroponically grown for 35 days followed by a 50 µM Mn treatment for 0, 2 and 4 days. The second leaves were infiltrated with dH_2O. Determination of the Mn content in the dry matter and AWF and peroxidase (POD) measurements in the AWF were carried out according to Fecht-Christoffers (2003).

Results:

1. The Mn tissue content and the Mn content in the AWF was much higher in rice than in barley.

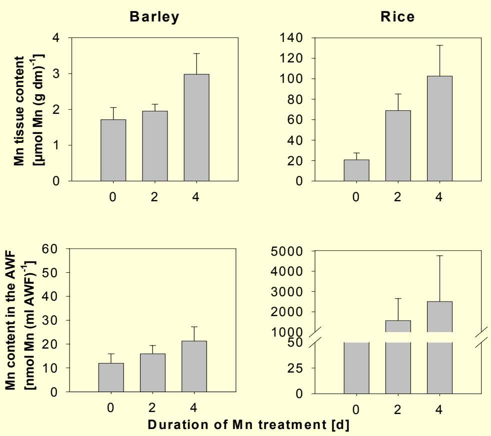

Fig.1: Mn tissue content and Mn content in the AWF of the second oldest leaves of barley and rice after 0, 2 and 4 days of Mn Treatment (50 µM).

2. Only in barley the number of brown spots as indicator for the severeness of Mn toxicity was highly correlated with the Mn tissue content and the activity of guaiacol-POD in barley.

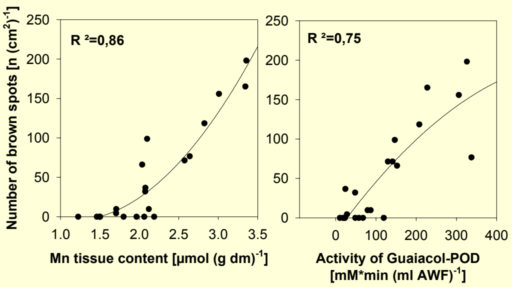

Fig.2: Relationship between the number of brown spots and the Mn tissue content and the activity of the guaiacol-POD in the AWF of second oldest leaf of barley after 0, 2 and 4 days of Mn treatment (50 µM).

3. Both, H_2O_2-consuming and -producing apoplastic peroxidase (POD) activities were 10 times higher in barley than in rice. In barley both activities correlated with the Mn tissue content. In rice only the guaiacol-POD showed a relationship with increasing Mn tissue content.

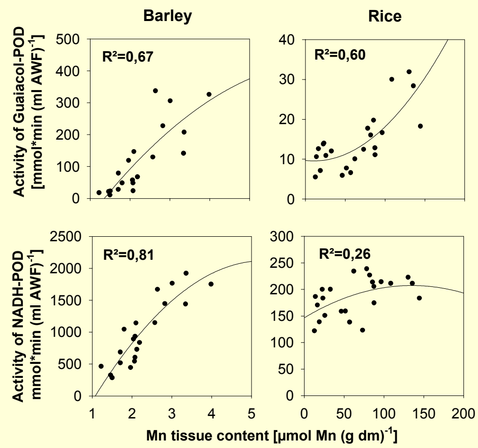

Fig.3: Relationship between Mn tissue content and activity of Guaiacol-POD and NADH-POD in the AWF of second leaves of barley and rice after 0, 2 and 4 days of Mn Treatment (50 µM).

Conclusion: In barley, POD activities correlated with the Mn tissue content, as it was shown previously for cowpea (Fecht-Christoffers et al., 2003, 2006, 2007) indicating the same reaction mechanisms. Therefore, in barley the apoplast seems to be the decisive compartment for the development of Mn toxicity. In rice, only a small increase of apoplastic POD activity was measured despite much higher symplastic and apoplastic Mn contents compared to barley. Therefore, the role of the apoplast in the high Mn tolerance of rice is unknown.

Refererences

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