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EFFECTS OF GEOMAGNETIC FIELD REVERSAL ON *ARABIDOPSIS THALIANA* DEVELOPMENT AND GENE EXPRESSION

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Together with gravity, light, temperature and water, the geomagnetic field (GMF) has been an environmental component for living organisms, including plants, since the beginning of Earth's evolution. The GMF is an abiotic stress factor for plants and we recently hypothesized (Occhipinti *et al.*, Trends Plant Sci., 2014, 19:1-4) that geomagnetic reversals might be involved in plant evolution. Geomagnetic reversals consist of changes in GMF polarity characterized by a period of low GMF. A correlation was found between the occurrence of GMF reversals and the moment of radiation of Angiosperms, leading to the hypothesis that alterations in the GMF polarity may play a role in plant evolution. To validate this hypothesis, we tested the effects of reversed GMF on morphology and gene expression of *Arabidopsis thaliana* Col 0 roots and shoots. To this aim, we built a triaxial Helmholtz coil-pairs magnetic field compensation system able to artificially reverse GMF conditions. Plants grown in Petri plates were exposed to both normal (control) and reversed (treated) GMF conditions. Root length and leaf areas were monitored for morphological analyses, while root and shoot total RNA was extracted for qPCR analyses on genes involved in plant growth: *Cruciferin 3* (*CRU3*), *Copper transport protein1* (*COTP1*), *Redox Responsive Transcription Factor1* (*RRTF1*) and the antioxidant genes *Fe Superoxide Dismutase 1*, (*FSD1*), *Catalase3* (*CAT3*), *Thylakoidal Ascorbate Peroxidase* (*TAPX*), a cytosolic *Ascorbate Peroxidase1* (*APX1*) and *NADPH/respiratory burst oxidase protein D* (*RbohD*).

We show a reduction of plant growth under reversed GMF, confirmed by a significant decrease in both root length and leaf area. These morphological events are correlated with the downregulation in roots and upregulation in shoots of *CRU3*, which is involved in cruciferin accumulation in the seeds. Upregulation of *COTP1* in both plant organs under reversed GMF conditions was associated to a reduced plant growth, possibly due to the harmful effects of copper when in excess. In addition, GMF reversal induced a significant overexpression of *RRTF1* in both plant organs. Considering that *RRTF1* is a transcription factor involved in the expression of genes to adjust to redox changes, our data suggest the occurrence of oxidative stress responses in treated plants. Although under reversed GMF conditions the expression of all antioxidant genes analyzed in shoots did not show significant changes, there was always a significant downregulation of all tested genes in roots. Thereby, our results suggest that roots might be involved in reversed GMF perception.

In conclusion, our data show for the first time that artificially reversing the GMF polarity has significant effects on plant growth and gene expression. This supports the hypothesis that GMF reversal may contribute to induce changes in plant development and that this event might justify a higher selective pressure, eventually contributing to plant evolution.