The changes of cabbage selected metabolites production in depending on herbivore insect attack

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Introduction

Plants are often exposed to various biotic and abiotic stresses which can affect their health stage, production quality and quantity. Great pests are herbivore insects which damage plants by suction and chewing. Plants detect insect herbivores via receptors of specific compounds which are present in saliva or other secrets (Fürstenberg-Hägg et al. 2013). Major pests of Brassicaceae are mainly *Pieris* sp. and *Phyllotreta* sp. Plants have various defensive strategies such as structural (trichomes, lignification) and synthesis of various chemical substances which can detect the herbivores or have toxic influence on them. The aim of this work was to find if the changes in the selected metabolites production already appear under the influence of eggs laying and under chewing of *Pieris* caterpillars. We also observed if the production of metabolites differs under the influence of *Phyllotreta* attack size.

Materials and methods

Seedlings of *Brassica oleracea* var. *capitata* cult. Slava F1 were cultivated in seeder size 5 × 5 × 5 cm. Each 8-cell tray was placed in a 29-litre transparent plastic box with two lateral ventilation. The plants were cultivated in a Fitotron growth room under the following conditions: 15-h photoperiod, temperature 22°C (day) /17°C (night), and humidity 60% (day) /70% (night). On the 17th July 2017 pests were added into the cultivation boxes in the following way: 3 control boxes without any insect, 3 boxes with *Pieris* adult butterflies (5 butterflies per box), 3 boxes with caterpillars (6 caterpillars per box), and 6 boxes with *Phyllotreta* (3 × 50 beetles per box, 3 × 100 beetles per box). The experiment was terminated partly on the 20th July (the control variant, variants with caterpillars and beetles), partly on the 24th July (the variant with adult butterflies). The leaves of plants were used for analysis. The concentration of superoxide, amino acids (Ala, Asn, Asp, Arg, Glu, Gly, His, Ile, Leu, Lys, Met, Phe, Thr, Tyr, Val) and ascorbic acid was determined (Ducaiova et al., 2016). The results were tested by the analysis of variance (ANOVA); significantly different values ($p < 0.05$) are indicated by different letters above the corresponding columns. The error bars in the graphs depict the standard error of the mean (SE).

Results and discussion

The concentration of the superoxide radical and the ascorbic acid seem to increase if the plant is attacked by *Phyllotreta* beetles (Fig. 1 and 2).

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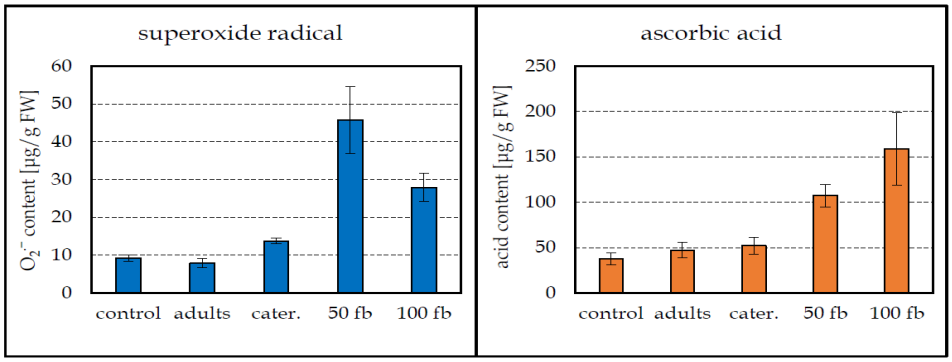

Figures 1 and 2: The superoxide radical and ascorbic acid content in the cabbage leaves (cater = caterpillars; fb = Phyllotreta beetles)

Superoxide radical is one of the forms of ROS (Reactive Oxygen Species), which serve as important signaling molecules. But often they become even the toxic intermediates of aerobic metabolism and cause damage to cell death. The response of plants to ROS lies in the activation of various antioxidant systems, where a key role plays the ascorbate and glutathione (ascorbate – gluthation cycle). The increased content of ascorbate is apparently a response to the stress induced mainly at higher damage to plants by *Phyllotreta*. We found a decrease in the content of most free amino acids in the infected plants in comparison with the control. Amino acids are important precursors of the synthesis of various substances, mainly defensive proteins, enzymes, phytohormones and a number of secondary metabolites of plants (alkaloids).

Conclusions

Plants respond to the herbivore attack by the increased production of superoxide radical. This was reflected mainly in *Phyllotreta sp.* attack and *Pieris* sp. attack. On laid by the eggs, and hatching of *Pieris* catepillars was plant reaction insignificant. The increased content of ascorbate in all infected plants in comparison with the control was observed. The ascorbate content also increased with degree of infestation by *Phyllotreta sp*. The increased ascorbate content occurred also after *Pieris* sp. egg laying. In infected plants by herbivores there was recorded the reduced content of almost all the studied free amino acids.

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