World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:13, No:09, 2019

Evaluation of Monoterpenes Induction in Ugni molinae Ecotypes Subjected to a Red Grape Caterpillar (Lepidoptera: Arctiidae) Herbivory

Authors : Manuel Chacon-Fuentes, Leonardo Bardehle, Marcelo Lizama, Claudio Reyes, Andres Quiroz

Abstract : The insect-plant interaction is a complex process in which the plant is able to release chemical signaling that modifies the behavior of insects. Insect herbivory can trigger mechanisms that allow the increase in the production of secondary metabolites that allow coping against the herbivores. Monoterpenes are a kind of secondary metabolites involved in direct defense acting as repellents of herbivorous or even in indirect defense acting as attractants for insect predators. In addition, an increase of the monoterpenes concentration is an effect commonly associated with the herbivory. Hence, plants subjected to damage by herbivory increase the monoterpenes production in comparison to plants without herbivory. In this framework, co-evolutionary aspects play a fundamental role in the adaptation of the herbivorous to their host and in the counter-adaptive strategies of the plants to avoid the herbivorous. In this context, Ugni molinae 'murtilla' is a native shrub from Chile characterized by its antioxidant activity mainly related to the phenolic compounds presents in its fruits. The larval stage of the red grape caterpillar Chilesia rudis Butler (Lepidoptera: Arctiidae) has been reported as an important defoliator of U. molinae. This insect is native from Chile and probably has been involved in a co-evolutionary process with murtilla. Therefore, we hypothesized that herbivory by the red grape caterpillar increases the emission of monoterpenes in Ugni molinae. Ecotypes 19-1 and 22-1 of murtilla were established and maintained at 25° C in the Laboratorio de Química Ecológica at Universidad de La Frontera. Red grape caterpillars of ∼40 mm were collected near to Temuco (Chile) from grasses, and they were deprived of food for 24 h before performing the assays. Ten caterpillars were placed on the foliage of the ecotypes 19-1 and 22-1 and allowed to feed during 48 h. After this time, caterpillars were removed from the ecotypes and monoterpenes were collected. A glass chamber was used to enclose the ecotypes and a Porapak-Q column was used to trap the monoterpenes. After 24 h of capturing, columns were desorbed with hexane. Then, samples were injected in a gas chromatograph coupled to mass spectrometer and monoterpenes were determined according to the NIST library. All the experiments were performed in triplicate. Results showed that α-pinene, β-phellandrene, limonene, and 1,8 cineole were the main monoterpenes released by murtilla ecotypes. For the ecotype 19-1, the abundance of α-pinene was significantly higher in plants subjected to herbivory (100%) in relation to control plants (54.58%). Moreover, β-phellandrene and 1,8 cineole were observed only in control plants. For ecotype 22-1, there was no significant difference in monoterpenes abundance. In conclusion, the results suggest a trade-off of β-phellandrene and 1,8 cineole in response to herbivory damage by red grape caterpillar generating an increase in α-pinene abundance.

Keywords : Chilesia rudis, gas chromatography, monoterpenes, Ugni molinae
Conference Title : ICABBBE 2019 : International Conference on Agricultural, Biotechnology, Biological and Biosystems Engineering
Conference Location : Tokyo, Japan
Conference Dates : September 09-10, 2019