World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:14, No:11, 2020

Application of Acoustic Emissions Related to Drought Can Elicit Antioxidant Responses and Capsaicinoids Content in Chili Pepper Plants

Authors : Laura Helena Caicedo Lopez, Luis Miguel Contreras Medina, Ramon Gerardo Guevara Gonzales, Juan E. Andrade

Abstract : In this study, we evaluated the effect of three different hydric stress conditions: Low (LHS), medium (MHS), and high (HHS) on capsaicinoid content and enzyme regulation of C. annuum plants. Five main peaks were detected using a 2 Hz resolution vibrometer laser (Polytec-B&K). These peaks or "characteristic frequencies" were used as acoustic emissions (AEs) treatment, transforming these signals into audible sound with the frequency (Hz) content of each hydric stress. Capsaicinoids (CAPs) are the main, secondary metabolites of chili pepper plants and are known to increase during hydric stress conditions or short drought-periods. The AEs treatments were applied in two plant stages: the first one was in the pre-anthesis stage to evaluate the genes that encode the transcription of enzymes responsible for diverse metabolic activities of C. annuum plants. For example, the antioxidant responses such as peroxidase (POD), superoxide dismutase (Mn-SOD). Also, phenyl-alanine ammonia-lyase (PAL) involved in the biosynthesis of the phenylpropanoid compounds. The chalcone synthase (CHS) related to the natural defense mechanisms and species-specific aquaporin (CAPIP-1) that regulate the flow of water into and out of cells. The second stage was at 40 days after flowering (DAF) to evaluate the biochemical effect of AEs related to hydric stress on capsaicinoids production. These two experiments were conducted to identify the molecular responses of C. annuum plants to AE. Moreover, to define AEs could elicit any increase in the capsaicinoids content after a one-week exposition to AEs treatments. The results show that all AEs treatment signals (LHS, MHS, and HHS) were significantly different compared to the non-acoustic emission control (NAE). Also, the AEs induced the up-regulation of POD (~2.8, 2.9, and 3.6, respectively). The gene expression of another antioxidant response was particularly treatment-dependent. The HHS induced and overexpression of Mn-SOD (~0.23) and PAL (~0.33). As well, the MHS only induced an up-regulation of the CHs gene (~0.63). On the other hand, CAPIP-1 gene gas down-regulated by all AEs treatments LHS, MHS, and HHS ~ (-2.4, -0.43 and -6.4, respectively). Likewise, the down-regulation showed particularities depending on the treatment. LHS and MHS induced downregulation of the SOD gene ~ (-1.26 and -1.20 respectively) and PAL (-4.36 and 2.05, respectively). Correspondingly, the LHS and HHS showed the same tendency in the CHs gene, respectively ~ (-1.12 and -1.02, respectively). Regarding the elicitation effect of AE on the capsaicinoids content, additional treatment controls were included. A white noise treatment (WN) to prove the frequency-selectiveness of signals and a hydric stressed group (HS) to compare the CAPs content. Our findings suggest that WN and NAE did not present differences statically. Conversely, HS and all AEs treatments induced a significant increase of capsaicin (Cap) and dihydrocapsaicin (Dcap) after one-week of a treatment. Specifically, the HS plants showed an increase of 8.33 times compared to the NAE and WN treatments and 1.4 times higher than the MHS, which was the AEs treatment with a larger induction of Capsaicinoids among treatments (5.88) and compared to the controls.

Keywords : acoustic emission, capsaicinoids, elicitors, hydric stress, plant signaling
Conference Title : ICPBM 2020 : International Conference on Plant Biomechanics and Mechanobiology
Conference Location : Jerusalem, Israel
Conference Dates : November 26-27, 2020