World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:17, No:05, 2023

Elucidating the Defensive Role of Silicon-Induced Biochemical Responses in Wheat Exposed to Drought and Diuraphis noxia Infestation

Authors : Lintle Mohase, Ninikoe Lebusa, Mpho Stephen Mafa

Abstract : Wheat is an economically important cereal crop. However, the changing climatic conditions that intensify drought in production areas, and additional pest infestation, such as the Russian wheat aphid (RWA, Diuraphis noxia), severely hamper its production. Drought and pest management require an additional water supply through irrigation and applying inorganic nutrients (including silicon) as alternative strategies to mitigate the stress effects. Therefore, other approaches are needed to enhance wheat productivity during drought stress and aphid abundance. Two wheat cultivars were raised under greenhouse conditions, exposed to drought stress, and treated with silicon before infestation with the South African RWA biotype 2 (RWASA2). The morphological evaluations showed that severe drought or a combination of drought and infestation significantly reduced the plant height of wheat cultivars. Silicon treatment did not alleviate the growth reduction. The biochemical responses were measured using spectrophotometric assays with specific substrates. An evaluation of the enzyme activities associated with oxidative stress and defence responses indicated that drought stress increased NADPH oxidase activity, while silicon treatment significantly reduced it in drought-stressed and infested plants. At 48 and 72 hours sampling periods, a combination of silicon, drought and infestation treatment significantly increased peroxidase activity compared to drought and infestation treatment. The treatment also increased β-1,3-glucanase activity 72 hours after infestation. In addition, silicon and drought treatment increased glucose but reduced sucrose accumulation. Furthermore, silicon, drought, and infestation treatment combinations reduced the sucrose content. Finally, silicon significantly increased the trehalose content under severe drought and infestation, evident at 48 and 72-hour sampling periods. Our findings shed light on silicon's ability to induce protective biochemical responses during drought and aphid infestation.

Keywords : drought, enzyme activity, silicon, soluble sugars, Russian wheat aphid, wheat
Conference Title : ICTRSPDPII 2023 : International Conference on The Role of Silicon in Plant Defences and Plant–Insect Interactions
Conference Location : London, United Kingdom
Conference Dates : May 15-16, 2023