DROUGHT STRESS COMMUNICATION BETWEEN PLANTS MEDIATED BY *Cuscuta* sp.

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1. INTRODUCTION

Dodder plants (Convolvulaceae: *Cuscuta* spp.) are holoparasitic plants distributed worldwide. Although some species have retained the capacity of synthesising chlorophyll, the overwhelming majority of their carbon assimilated comes from the plants they parasite (JESCHKE et al., 1994; BIRSCHWILKS et al., 2006; KIM; WESTWOOD, 2015). For doing so, dodders attach to their hosts with special structures named haustoria and penetrate their stems and leaves with specialised cells called hyphae. They bond the hyphae to the host's vascular tissues for stealing the sap. Hyphae that connect to the xylem differentiate into xylic hyphae, and hyphae that connect with the phloem differentiate into phloic hyphae (VAUGHN, 2006). After the haustorium maturation, the vascular bundles of both host and parasite are perfectly connected, forming a single vascular *continuum*. This creates an efficient medium for communication between the parasitised plants, which can be connected by a single dodder.

It is known for more than 70 years that different plants parasitised by dodders can exchange molecules such as sugars and even viruses (BENNETT, 1944; LITTLEFIELD et al., 1966; BIRSCHWILKS et al., 2006). Until recently, only the gloomy side of this ecological interaction was known. However, HETTENHAUSEN et al. (2017) have demonstrated that meaningful ecological information can be exchanged between hosts via dodder-bridges. They have demonstrated that both Arabidopsis (*Arabidopsis thaliana* (L.) Heynh.) and wild tobacco (*Nicotiana attenuata* Torr. ex S.Watson), when connected by dodder-bridges, can exchange signals about herbivory and induce the transcription of defence-related genes in plants that are not under caterpillar attack, thus increasing their resistance to herbivores. Even plants sequentially connected by dodders could transmit this information plant-by-plant over one metre. According to the authors, this 'message delivering service' offered by the dodders could be a form of mitigating the losses that the parasite is causing to its hosts (HETTENHAUSEN et al., 2017). If they can communicate some trouble, they might survive longer.

To our knowledge, no studies assessing the communication of abiotic stresses where performed hitherto. So, we have hypothesised that plants suffering from drought stress could communicate their condition to other plants via dodder-bridges too, leading to physiological alterations in the plants that received the stress signals.

2. MATERIAL AND METHODS

Experimental sets (n = 10) were mounted with three bean plants (*Phaseolus vulgaris* cv. Expedito), two of them connected by a dodder plant (*Cuscuta* sp.). For simulating the drought stress, a polyethylene-glycol (PEG) solution at −2 MPa was applied to the roots of one of the bean plants, and the entire set was monitored throughout 2,5 h (half an hour before, and 2 hours after PEG application) with a thermal camera for accompanying the plants' temperatures. With a leaf porometre, the stomatal conductance was measured just before and 2 h after applying PEG. All the assays were performed in the morning hours (~8:30-11:00 a.m.) in the laboratory.

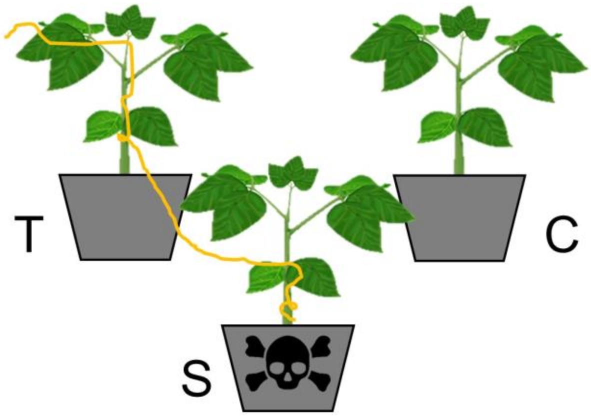

Figure 1: Schematic representation of an experimental set. **S**: sender plant, which receives the stressing stimulus. **T**: target plant, which is dodder-connected with S plant and presumably receives the signals of stress. **C**: control plant.

3. RESULTS AND DISCUSSION

With the obtained stomatal conductance values, it was calculated the normalised index of variation. After the PEG application, the index of the dodder-communicating plants was lower (−0.033) than the control plants (+0.060) (Figure 2). Tuckey Test confirmed this difference ($p < 0.05$). The temperature of the leaves of each plant was measured with the thermographic photograph with the program FLIR Tools© (FLIR® Systems, Inc.). It was not found a significant difference in the control and target plants' temperatures, although there was a trend in the target plants to be warmer than the control ones (Figure 3).

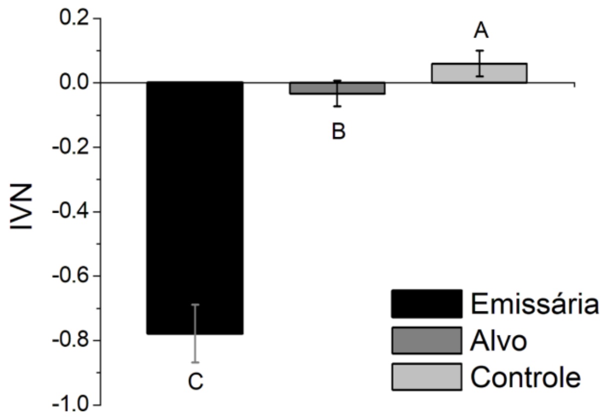

Figure 2: The normalised index of variance graph for the stomatal conductance with standard deviations (n = 10). **Black bar**: Sender plant. **Dark grey bar**: Target plant. **Pale grey bar**: Control plant. Different letters indicate statistically significant differences.

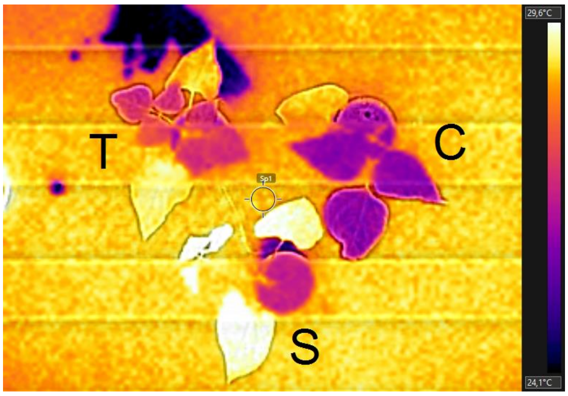

Figure 2: A thermographic photograph of an experimental set. Note that the stressed sender plant (**S**) has a higher temperature than the target (**T**) plant, and the control (**C**) plant is the coolest one among them. This is probably related to the stomatal conductance variation, although the ensemble of thermographic data did not show statistic relevant differences between T and C plants.

4. CONCLUSIONS

The results demonstrate that stomatal conductance of dodder-communicating plants tended to decrease, while the conductance of control plants tended to rise, maybe following a natural circadian dynamic since the experiments were carried on in the morning. It suggests possible anticipation to the putative forthcoming stress due to the communication mediated by the dodder plants. It would be worthy to investigate the nature of this communication, for many pathways such as chemical, hydraulic and electrical ones might be involved.

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