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Editorial

Understanding Plants' Language: A Contribute to Tackling Plant Blindness

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We live surrounded by plants. Every day, we come across countless plants, whether in the countryside or on the streets of our cities. However, at the end of the day, we have a hard time remembering, let alone naming, any of them. This phenomenon—the invisibility of plants to most people—alongside the inability to recognise the importance of plants for the stability of the biosphere and the global economy, the inability to appreciate the aesthetic beauty of plants, and the idea that they are inferior to animals, are what botanists and educators James Wandersee and Elisabeth Schussler have called 'plant blindness' [1].

Plant blindness has several important negative consequences, including the reduced attractiveness of botany and plant science courses for young people interested in biology [2], and the relatively low priority that plant sciences receive in public policies (compared, for example, to health sciences), which results in a chronic funding deficit for research in plant biology [3]. All of this makes it more difficult to address one of the most important challenges facing humanity: ensuring food and nutritional security for a growing population in an adverse context dictated by climate change [4].

It is therefore important to combat plant blindness, which has diverse causes that are not completely understood. It has been argued that the biological characteristics of plants, such as their uniform green colour, significantly contribute to plant blindness [5]. Additionally, the (mistaken) perception of the absence of movement in plants leads to their devaluation [6] and perception as inferior organisms that, due to their simplicity, are incapable of exhibiting 'behaviour', in contrast to animals. Aristotle attributed the immobility of plants (which he considered to be intimately linked to the earth, being constitutively composed of earth and water) as the reason for their structural simplicity and the absence of 'sensation' and 'imagination', — qualities necessary for mobile animals to orient themselves in the environment [7]. However, these initial ideas about the constitution and nature of plants evolved as knowledge about their biology increased. In particular, the growing understanding about their signalling and regulatory mechanisms is increasingly allowing us to build an image of plants as fascinatingly complex beings. Highlighting this complexity will help to counteract one of the perceptions that feed plant blindness, thereby helping to combat this phenomenon. In this context, the growing knowledge that bioelectrical signals play a central role in plant physiology is crucial.

In his book, 'The Power of Movement in Plants', published in 1880, Charles Darwin, assisted by his son Francis Darwin, proposed that the root tip of a plant acts like a "brain-like" organ, essentially acting as a functional analogue of the brain of lower animals, which is now known as 'the root-brain hypothesis'. In fact, Darwin wrote "It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the movements of the adjoining parts, acts like the brain of one of the lower animals" [8]. Encouraged by Darwin, the English physicist and physiologist Sir John Scott Burdon-Sanderson first established the relevance of electrical processes in plant physiology, specifically in the movements of carnivorous plants [9].

From these foundational moments in the 19th century, electrophysiological techniques have slowly gained ground in plant biology, with periods of disinterest and even antagonism. In fact, the measurement of electrical phenomena in plants has often been linked to the ideas of the 'nervous system', 'intelligence', and 'sentience' [10]. The disruptive and controversial ideas of 'plant intelligence' and 'plant sentience' have alienated the mainstream of plant physiologists from electrophysiology studies [11]. Admittedly, it is an area that is strongly connected to fundamental values and capable of arousing passions, making it susceptible to incursions of pseudoscience — which, in fact, have occurred [12]. However, it is important to overcome these limitations and continue to develop plant electrophysiology, because, as well as highlighting the complexity of these organisms, it has the potential for various practical applications.

The return of electrophysiology to the mainstream scientific agenda has not yet generated such significant practical applications, but hopes are high. The existence of electrical signals in plants, transmitted over medium distances between different organs, has now been indisputably established. It also appears that the phloem is the main conductor of electrical signals in plants. However, due to electrical dissipation (which is prevented in animal nerves by the myelin layer), the speed of electrical transmission in plants is several orders of magnitude lower than in animals.

Recently, a strong correlation between the rainfall and bioelectrical signals has been established in pine trees. The rain-intensity correlation, together with sustained intensity values during the reproductive period in spring, suggests that this electrical magnitude could be an indicator of the physiological state of the tree and thus used for *in situ* and minimally invasive forest monitoring [13]. The development of more robust measurement systems, capable of accurately measuring bioelectrical signals without the use of Faraday cages, also opens prospects for their use in horticulture. The electrical signals produced by tomato plants vary with ripening stage, and the use of machine learning techniques has made it possible to classify the ripening stage of fruits based on electrophysiological measurements [14]. Additionally, bioelectrical signalling has been used for the early diagnosis of plant diseases. In barley, leaf infection by different pathogens generates different bioelectrical responses, allowing the identification of specific diseases before any visual symptoms [15].

In conclusion, the growing understanding of signaling processes in plants has highlighted their complexity and led a growing number of biologists to consider them ‘behavioral organisms’. This could be an important step towards combating plant blindness — the human cultural and psychological limitation that compromises due consideration of plants’ importance to the planet and humanity. Furthermore, technical advances in the study of plant signalling and communication are boosting the emerging (and still controversial) field of plant semiotics, the study of how plants communicate and interpret signals within their environment, and enlightening multiple applications of the fundamental knowledge produced within.

Declaration of AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the author used DeepL Translator in order to check spell and grammar and Microsoft Copilot in order to suggest bibliographic sources. After using these tools, the author wrote, reviewed and edited the content as needed and takes full responsibility for the content of the publication.

Author Contributions

JMdS was responsible for the conception of ideas presented, writing, and the entire preparation of this manuscript.

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Conflict of Interest

Given his role as the Editorial Board member, Jorge Marques da Silva had no involvement in the peer-review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Graham Pawelec.

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