



HAL
open science

The Intelligence of Plants: A New Narrative? Notes on a Contemporary Cultural Phenomenon

Andrea Catellani, Céline Cholet, Céline Pascual Espuny

► **To cite this version:**

Andrea Catellani, Céline Cholet, Céline Pascual Espuny. The Intelligence of Plants: A New Narrative? Notes on a Contemporary Cultural Phenomenon. 2023. hal-04183214

HAL Id: hal-04183214

<https://hal.science/hal-04183214>

Preprint submitted on 18 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Public Domain

The intelligence of plants: A new narrative?

Notes on a contemporary cultural phenomenon

Authors

Corresponding author: Andrea Catellani, LASCO-ILC, Catholic University of Louvain (UCLouvain, Belgium). andrea.catellani@uclouvain.be ORCID: 0000-0002-2362-6423

LinkedIn: <https://www.linkedin.com/in/andreacate/>

Céline Cholet, CHUS, Catholic University of the West (UCO, France). c.cholet@uicolaval.net

LinkedIn: <https://www.linkedin.com/in/c%C3%A9line-cholet-66b3ba16b/>

Céline Pascual Espuny, IMSIC, University of Aix-Marseille (France). celine.pascual@univ-amu.fr ORCID: 0000-0003-3156-440X

LinkedIn: <https://www.linkedin.com/in/celine-pascual-espuny-23ab879/>

This is a preprint (original manuscript) of an article published by Taylor & Francis in *Environmental Communication* on 13 July 2023, available at: <https://doi.org/10.1080/17524032.2023.2234654>

Complete reference: Andrea Catellani, Céline Cholet & Céline Pascual Espuny (2023). The Intelligence of Plants: A New Narrative? Notes on a Contemporary Cultural Phenomenon, *Environmental Communication*, 17:6, 618-633, DOI: [10.1080/17524032.2023.2234654](https://doi.org/10.1080/17524032.2023.2234654)

Abstract

This article explores the development of a new vision in French media productions of plants as beings with intelligence and sentience. The first part of the article presents data on the increase in the number of media about plants and, particularly, plant intelligence and sentience, in France, between 2014 and 2020. A multimedia corpus composed of books, magazine issues and documentaries is the basis for this assessment. The second part proposes an observation of a part of this corpus, aiming at identifying some specific visual and textual devices related to the staging of the intelligence and sensitivity of plants. The third part proposes some theoretical observations concerning the semantic work involved in the new narrative of plant intelligence and sensibility and its implications for the Western vision of plants. The article shows this new narrative has challenged Western *naturalism*, as defined by Descola, and shaken its ontological structure.

Keywords: plants, vegetal, intelligence, sensitivity, media, naturalism, discourse

The authors report that there are no competing interests to declare.

Introduction

For a few decades, scientific literature (Calvo, Keijzer, 2009; Gagliano *et al.*, 2012; Trewavas, 2016; Calvo *et al.*, 2020; Parise *et al.*, 2020) and general public literature (Pollan 2001; Tassin, 2016; Chamovitz, 2018; Wohlleben, 2017; Mancuso & Viola, 2018) have been increasingly talking about a new way of looking at plants. Discussions have focused in particular on cognition (Segundo-Ortin & Calvo, 2021), intelligence (Trewavas, 2016; Calvo, Gagliano, Souza, Trewavas, 2020; Nick, 2021) and even consciousness (Segundo-Ortin & Calvo, 2021) of plants. Both texts and images used in these publications reflect new ways of apprehending and thinking about plants (Baluska & Mancuso, 2020). This article aims to analyze the development of this new vision of plants, focusing on media productions in a specific country, France, concerning in particular the attribution to the plant beings of cognition, intelligence and sensitivity, characteristics more often attributed to the animal world, and eminently to the human being. We focus in this paper in particular on books, documentaries and magazine issues. Each title and text in French will also be presented in its English translation, in the next pages. The results of this study, although limited to a corpus of French origin, can feed broader

research on the presence of plants in culture and media, in particular on the theme of the intelligence of plants.

Through our analysis, we observe a polymorphous cultural evolution: around the plant, its intelligence and sensitivity, are inscribed narratives that circulate among different texts and constitute an interdiscourse, and the web thus woven is rich in teachings on our relation to plants, but also on our relation to “Nature” in general. Our main research question is:

- how the theme of plants intelligence and sensitivity manifests itself in mediatic productions in France?

To answer this question, we propose three analytical steps and sub-questions. First of all, we will quantify this media emergence.

- Which is the quantitative evolution of the presence of plants intelligence and sensitivity in French mediatic productions?

Secondly, we will develop an exploratory, inductive analysis, focused on a specific sub-corpus of popular science books and supports. This approach, inspired by semiotics, allows us to answer the second sub-question:

- which are the specific multimodal patterns (visual, verbal) of the media representations of plants intelligence and sensitivity in France?

Thirdly, basing on a semiotic and anthropological approach, we focus on the evolution of the ontological regime (Descola, 2005, 2021) which seems to appear in the mediatic productions observed and explored, concerning the place of plants in relation to humans and animals.

- Which changes appear in the ontological regime implicit in the French mediatic productions?

Before these three sections, we present the methods we used to answer our questions. Then, we offer a very short historical and cultural contextualization of the presence of plants in Western culture. We present the results of our inquiry concerning the three analytical steps, and we end with a global conclusion.

1. Methods

How to observe a cultural evolution like the mounting of discourses on plants intelligence and sensibility? We could have focused on the quantitative and thematic evolution of media production only, via techniques like content analysis and linguistic corpus analysis. We also could have analyzed this corpus with qualitative tools only, like the ones of multimodal analysis or critical discourse analysis. Finally, we could have tried to observe the evolution of the Western vision of plants from an anthropological and philosophical point of view only, just basing on some examples as starting points. Instead, we tried to combine these three complementary approaches in order to connect the reflection on the ontological implications of this cultural phenomenon with a concrete exploration of its mediatic “incarnations”. This implies a structure in three phases: a first one to quantify the cultural phenomenon; a second one that explores a part of these media productions in order to identify specific discursive patterns; finally, a third one that tries to deep into the semantic “work” concerning plants in contemporary culture, with an opening towards the ontological implications.

Concerning the first sub-question (section 3), we observed the quantitative evolution of the theme of plants intelligence and sensitivity by collecting documents via research made on a list of search engines. We have used a few keywords: "plants", "intelligence", "sensitivity", "vegetation". We applied this list on several search engines: *Factiva* for the press, *Ina* for the television archives, and the radio archives of *France culture* radio. We also made a systematic analysis of the works published on Summon and Google Scholar, completed by a systematic review of the *L'Ecologiste* (French journal version of *The Ecologist*). We obtained a corpus of 118 practical books, illustrated books, children's books, museum exhibitions, radio programs, magazine features or special issues, and television documentaries. We will present in section 3 the results of this data collection and observation, focusing in particular on books and magazine features.

Concerning the second subquestion (on specific multimodal patterns of the media representations of plants intelligence and sensitivity in France, section 4), we selected a sub-corpus made of audiovisual documentaries and reports: in particular, “*L’intelligence des plantes*” (The intelligence of plants, 2014), “*Le secret des arbres*” (The secret of trees, 2017), and “*Le murmure de la forêt. Quand les arbres parlent*” (The murmur of the forest. When the trees speak, 2019); some books (Wohlleben 2017, Tassin 2016, Mancuso and Viola 2018, and Chamovitz 2018); finally, an issue of the popular science magazine *Science et Vie* (Science and

life, 2019). These supports were chosen because they are significant examples of the media production in French language (or translated in French and broadcasted in France) dedicated specifically to the theme of the intelligence and the sensitivity of plants between 2014 and 2020. We observed these supports in an exploratory way, without applying a predefined analytical grid: we carried out a reading or watching of the media, to identify any type of particular features related to the verbal and visual representation of the plants, in an inductive way. An inspiration for this exploratory observation was the semiotic tradition, which tries to identify potential meaning (the signified) and their visual and textual basis or signifiers (Barthes 1977, Hébert 2020, Catellani 2022).

Section 5 develops the answers to the third sub-question, concerning changes in the ontological regime of plants implicit in the French mediatic productions observed in the previous sections. This step is based on a theory-based observation of the whole corpus presented in section 3, with a specific focus on books; it is also based on the writings of some other researchers that have contributed to the development of these themes. The main theoretical references of this section are the anthropologist P. Descola (2005, 2021) and the philosopher and semiotician J.-F. Bordron (2011).

2. Historical context and literature review

2.1. Historical roots: an ambivalent perception about the place of plants in Western culture

Plants have an important place in religions (see the different trees in the biblical book of Genesis, or in the life of Buddha). As for Western philosophy, plants have been present in philosophical reflexion, in a minor way in relation to animals, since the ancient Greek. Tensions concerning cognitive powers of plants appear during the whole history of Western civilisation, with a domination of positions that relegate plants to a place of inferiority in relation to animals and men, as immobile beings without sensoriality. The birth of the modern vision of plants and of botany is linked to the works of authors like Von Humboldt, Linnaeus, Jussieu, Rousseau, Ray, and Goethe. The French philosopher Descartes (XVII century AC) contributed to the construction of the modern mechanistic view of nature, and plants. On the contrary, Charles Darwin (XIX century) considered that the structure of plant roots is similar to that of neural networks, and studied carnivorous plants and plants that show visible movement (*The Power of Movement in Plants*, 1880).

Botanical research on the sensory, communicative and cognitive capacities of plants has successively developed, in particular since the 1990s. An international group of researchers (like Stefano Mancuso, Monica Gagliano, Frantisek Baluska, and others) has developed this field, notwithstanding the oppositions and criticism of other scientists. This development culminated in 2005 with the creation of the Society for Plant Neurobiology, later renamed - in a less provocative way - as Society of Plant Signaling and Behavior (2009, <https://www.plantbehavior.org/about-us/>). We focus in this paper on some aspects of this contemporary cultural phenomenon concerning plants intelligence and sensitivity, linked to the spreading of new scientific results.

2.2. Literature review on plants intelligence and sensibility

The notion of plant intelligence has been developed in particular, in recent years, by Trewavas (2003, 2016), and largely discussed by authors with different disciplinary origins and positions (Hendlin 2022). A major issue is the status of plant “intelligence”: is it a metaphor or a reality (Cvrčková, F. *et al.* 2009)? A recent polemic has opposed Baluska & Mancuso (2020), which exalted the role of plants in climate change mitigation, to Robinson *et al.* (2020), that criticized the application of words concerning intelligence to plants behavior. French philosophers like Coccia (2016) and Burgat (2020) have discussed the transfer of categories traditionally reserved for humans (and partly animals) to plants (see also Hiernaux & Timmermans 2019 and n. 20 of the Journal *La pensée écologique*, 2020).

Authors members of the Society of Plant Signaling and Behavior, and those that publish in the *Plant signaling and behavior* Journal, are active in spreading their ideas also outside the scientific sphere (eg. *Brilliant Green* by Mancuso and Viola, 2015), together with other non-scientific authors like Peter Wohlleben (*The Hidden Life of Trees*, 2016) and writers like Richard Powers (*The Overstory*, 2018).

In the field of semiotic studies, phytosemiotics (Kull 2000) has developed as a branch of biosemiotics, focusing on how plants manifest forms of sign processes, with specific vegetative sign systems (Faucher 2014). Other fields have developed in the last decades, like “plant geography” and the “critical plant studies”, which focus on themes like plant otherness, ethics and “plant-human attunement” (Lawrence 2021).

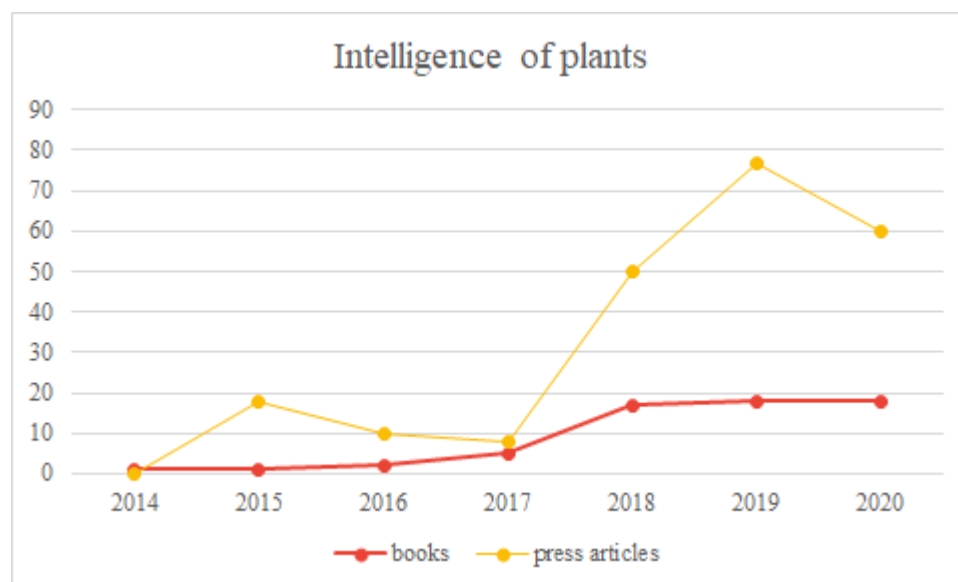
Globally speaking, the communication studies approach to the themes of plant intelligence and sensitivity have still to be developed, and this paper is a contribution to that. Some researchers have explored communications implying forests and on forests, for example concerning the

promotion of reforestation (Chung *et al.* 2020), communications concerning the forest sector sustainability (Korhonen *et al.* 2016), and the relation between humans and forests (Farcy *et al.* 2018). An ICA (International Communication Association) pre-conference in France has been recently dedicated to the relation between communication and plants (<https://vegetals.sciencesconf.org/>, May 24, 2022). But communication and discourses concerning specifically plant intelligence and sensitivity still deserve wider explorations by communication scholars.

3. Diachronic analysis of the emergence of plants' intelligence et sensitivity in the French public space

A diachronic analysis between 2014 and 2020 reveals a quantitative increase of the presence of plants intelligence and sensitivity in French general public media. This allows, as we shall see, to argue the idea of the appearance of a real media and cultural trend.

As shown in fig. 1, the newspaper articles offer the most visible increase, together with the number of books¹.



¹ We focus here on the quantitative evolution of books and press articles. Complete information on data and treatment is available from the corresponding author. A complete quantitative survey of data on documentaries and exhibitions has still to be done.

Fig. 1: quantitative evolution of publications on the intelligence and sensitivity of plants between 2014 and 2020.

Some more qualitative comments can be added concerning books. The increase started around the years 2014-2015 with some precursory French works, like "*Les langages secrets de la nature: la communication chez les animaux et les plantes*" (The secret languages of nature: communication in animals and plants, Pelt & Steffan, 2014). This book already laid the groundwork for the movement to come. But it was indeed another international best-seller, "*L'intelligence émotionnelle des plantes*" (The emotional intelligence of plants, Backster et al., 2015) that delineated a new narrative and prepared a fertile ground for the emergence of plants' intelligence and sensitivity in the public space.

2017 publications clearly mark a turning point: collections are opening up, the world of plants is decoded from a multitude of different angles, bestsellers are published (the works of Peter Wohlleben or Francis Hallé in France). This same year 2017 introduces another perception of nature and of the relationship with living beings: books such as "*La vie secrète des arbres*" (The secret life of trees, Wohlleben, 2017), "*Écoute l'arbre et la feuille*" (French translation of the book: "*The Songs of Trees: Stories from Nature's Great Connectors*", Haskell, 2017), "*Comment pensent les forêts*" (2017, translation of the book: Kohn, E. (2013), *How forests think: Toward an anthropology beyond the human*, Univ. of California Press, 2013), or the issue of the popular science journal *Sciences et vie* (December 2017) mark a significant change.



Fig 2: major bestsellers books published in France in 2017

An interdiscursive framework emerges, in a cascading media dynamic: upstream, there are books, often translations of world bestsellers, which are more successful in France than in other

parts of the world (cf. Wohlleben's book²). These works open the way to many other publishers, who will release in the following years other works on plants, gardens and forests. 2018 is in line with 2017, with many books digging the furrow of the intelligence of plants and their sensitivity: “*L’intelligence des plantes*” (The intelligence of plants, Mancuso & Viola, 2018) ; “*L’intelligence des plantes*” (Daugey, 2018); “*La vie secrète des plantes*”, Tomkins & Bird, 2018³; “*Les émotions cachées des plantes*” (The hidden emotions of plants, Van Cauwelaert & Clerc 2018); “*Le langage secret des arbres*” (The secret language of trees, Thoma, 2018); “*Le monde fantastique des arbres*” (The fantastic world of trees, Mizcek, 2018); “*Penser comme un arbre*” (think like a tree, Tassin, 2018); “*La plante et ses sens*” (The plant and its senses, Chamowitz, 2018).



Fig 3: major bestsellers books published in France in 2018

2019 and 2020 publications continue and enrich the interdiscursive framework on plants, allowing each media genre to appropriate its different literary angles: we thus find examples of the “heroization” of the struggle for plants in novels and children's fiction, scripted and magnified investigations in the illustrated books, practical care books and publications that mix legendary and scientific considerations. Popular science books are published (F. Hallé, “*Mais d’où viennent les plantes ?*”, But where do plants come from?, 2018) at the same time as books of art and illustrated books multiply and propose a dreamlike and mysterious world (“*Le tour du monde en 80 arbres*”, The world tour in 80 trees, Pakenham, 2019; “*Fleurs théâtrales*”,

² The book has sold more than 1 million copies worldwide: 700,000 copies in Germany and 250,000 copies in France (as much as the Goncourt prize). https://fr.wikipedia.org/wiki/La_Vie_secr%C3%A8te_des_arbres

³ The new French edition of a 1973 American book by Peter Tompkins and Christopher Bird.

Theatrical flowers, Jean, 2019;). This increasing literature about trees and plants is focusing on new publics, as in the case of children's literature on plants, which is a great novelty ("*Un arbre, une histoire*", A tree, a story, Benoît, 2018). Reports that defend plants and that develop a political rhetoric, discuss the economics of plants and highlight the heroic struggle of some men find their audience too (eg *Main basse sur nos forêts*", Hands down on our forests, d'Allens, 2019; "*Le messie des plantes*", The Messiah of plants, Magdalena, 2018,).

A whole literary, written and visual field emerges, with its own codes, followed by exhibitions and special issues of magazines (eg. *CERES*, 2018, "*L'imaginaire des céréales*", the imaginary world of cereals; *Le point*, 2019, "*La philosophie des jardins*", the philosophy of gardens). Finally, the audio-visual media also contribute their stone: many docu-features allowing to perceive the strange plant tempo and rhythm (see 2.1). We discover the breath of the forests, the hypnotic rhythm of the canopy, which can be perceived by humans only in accelerated mode.

As a conclusion, a real emergence, which pollinates in all written, literary, but also audio-visual media marks these years 2017-2020. The interests for plants include a specific flow of media that focuses, in whole or in part, on the intelligence and sensitivity of the plants. The following section will focus on the identification of some major semiotic aspects that characterize these discourses on plants, their intelligence and their sensitivity.

4. Plants in books, magazines and documentaries: verbal and visual features

We have applied an exploratory analysis to a subset of documents, aimed at answering this question: which are the specific multimodal patterns of the media representations of plant intelligence and sensitivity in France? We focus in particular on visual patterns (specific visual effects present in still and moving images) and on linguistic patterns.

4.1. Visual features: acceleration, close-up, animation as a spectacular othering

A global result of our analysis is the centrality of three visual features: acceleration, close-up and animation/special effects.

Wohlleben (2017) and Mancuso and Viola (2018) are clear in their books: a major obstacle to the perception of plants as active, "intelligent" and sensible beings (and to the

improvement of their position on the ladder of the living inherited from the past) is that apparently they don't move, and this absence of movement makes them nearer to non-living beings. So, it is not surprising that acceleration of plant movements is used in documentaries like "L'intelligence des plantes" and "Le murmure de la forêt. Quand les arbres parlent". In the first one, for example, the growth of an ivy on a trunk is accelerated, and the result is a sort of zoomorphic visual transformation (fig. 3).



fig. 3. A still from the documentary "L'intelligence des arbres".

The spikes are filmed very closely, and they move as animal fingers. The sound of plant creaks is amplified, to emphasize the movement. The verbal text exercises its typical function of "anchorage", as it has been studied by the French semiotician Roland Barthes (1977): "like fingers looking for a hold, the spikes of this ivy stick to the bark". Here and later, in the sequence dedicated to carnivorous plants, this movie shows a certain taste for the macabre: plants appear as powerful and somehow menacing beings, and this contributes to the construction of an "empowered" image of plants, and operates as a factor of the spectacular "reading contract" established with the viewer (a proposition of fun and pleasure). The power to kill animals is added to movement, revealed through acceleration, as two aspects of a zoomorphic change in the image of plants. Acceleration is signaled also by Monica Gagliano (2015, 5) as an important tool to overcome the traditional (aristotelian) idea that plants cannot move and so they are not active: "Indeed when considered in animals including humans, behavior generally implies movement (action) and cognitive capacity (agency). Currently, this consideration is not usually extended to plants because evidence for both action and agency has gone undetected until the

recent advent of advanced high-speed cameras, for example, allowing us to shift our perceptual range into one that relates to plants”.

Close-up images are a quite obvious complement of acceleration, in order to reveal the new face of plants. In the documentaries, close-up creates a focus on plants and a sense of proximity and intimacy, resulting in the fact that familiar and often unobserved beings (plants) become unusual, as in the case of the ivy spikes. We could call it a “spectacular othering”: the familiar becomes different, with spectacular effects; speed (or slow motion) to show movement and close-up contribute to a semantic change.

Another semiotic tool used for this semantic transformation is animation. The documentary “Le murmure de la forêt. Quand les arbres parlent” is full of sequences in which animation is used to get the observer beyond the ordinary appearance of plants. For example, the circulation of electrical signals in the tree trunk and between trees, via the underground network of roots and fungi that connect the roots of different trees to each other (the mycorrhiza), is represented by rhythmic light impulses. It becomes a sort of recurring trait of style in this documentary, that mixes together photographic images and animated effects; “Le secret des arbres” (2017) uses the same features.

Artificial colors, lights and images are used to make visible also the spread of pollen by conifers, the effects of pests on weakened firs, and also non vegetal phenomena like the peculiarities of the movement of the heads of the woodpeckers when they strike the trunks. The mixing of these “special effects” with “ordinary” (non-modified) images create at the same time a) an effect of wonder, of spectacular, and b) a cognitive effect of pedagogy and deep penetration into the essence of things. Artificial images operate as a visual "prosthesis" that gives the observer the power to watch the world “inside and outside”, getting rid of perceptual and cognitive limitations. This empowerment of the observer is correlated to the one of plants themselves; images acquire a specific cognitive power.

As a conclusion, technical features are necessary to break the barrier of the established vision of plants, with the aim of getting closer, of changing the cognitive and cultural schemes, and also, of course, of playing on the register of the marvelous and the spectacular to create the “Plaisir du texte” (pleasure of text in Roland Barthes’ words, which is also a basic goal of media and cultural industries).

4.2. Verbal features : “intentionalism”, metalanguage and polemic

A first verbal basic feature we are able to identify in the sub-corpus is the utilization of anthropomorphic and zoomorphic vocabulary. The established structure of semantic fields is distorted to make space to a new vision of plants, their capabilities and properties. This phenomenon is present in a massive way in all the supports (magazines, books, documentaries). For example, the *Science & Vie* issue (2017) opens with the title “they think!”, and the first sentence of the main article of the issue says: “gifted with memory, capable of making decisions and even learning: plants demonstrate cognitive abilities as exceptional as those of animals”. In the Wohlleben book we read that “plants are perfectly capable of distinguishing their roots from those of different species”. The documentary movie “L’intelligence des plantes” includes this sentence: “The plant has apparently found an ingenious solution”.

Entire lexical fields are “transferred” from humans and animals to plants. This concerns in particular words on cognitive capabilities: memory, intelligence and communication. It also includes different types of sensoriality (sight, hearing, taste, smell) and sensitivity, and the capability of being an actor that makes its own actions based on knowledge and reflection.

We could call it an “intentionalist” discourse, because plants (and in particular, trees) appear to be endowed with the abilities normally attributed to humans and, in part, superior animals (will, duty, strategic thinking, memory), and by marks of intentions and intentional acts (liberate, foresee, test, follow a strategy, social attitudes and characters...). The book by Wohlleben is full of this kind of vocabulary. “the trees *avoid* resting on the only way of the air... they *prefer* to secure their backs by also sending their messages to the roots” (p.22). “a forest also shelters loners and individualists refractory to any idea of collaboration” (p. 23). Species of trees each have their own “germination strategy” (41). Trees (and other plants, in particular when they are not cultivated) communicate and exchange information and signals, and do that also with animals. In the *Science & Vie* issue, titles are very “intentionalist”: “they make choices and make real decisions” (50); “they are gifted with memory” (52); “they learn from their experiences” (54).

Mancuso and Viola use this type of vocabulary in a displayed and deliberate way. “Today, almost a century and a half later [in relation to the seminal researches of Charles Darwin on plants], an impressive body of research has shown that plants are indeed intelligent, *i.e.* capable of receiving signals from their surrounding environment, processing the information obtained and calculating solutions adapted to their survival”. The documentary “The intelligence of plants” used a similar language, for example: “The plant has apparently found an ingenious solution”.

This kind of “intentionalist”, anthropomorphic and zoomorphic discourse has to be managed by the authors, in order to become acceptable to the intended reader. To do that, two strategies are basically used. The first one is typical of texts like the book by Wollheben and the documentary “The intelligence of plants”: intentionalist language is used without any form of mediation, modulation or moderation. In other cases, it is introduced and commented on via meta-discursive texts that make reference to other parts of the same text, or to the functioning of discourse and language (Hébert 2020). Some authors use the metadiscursive function of language in an intense way while talking about plants' intelligence and sensitivity. They try to negotiate meaning. How can we transfer words like “intelligence” or “communication” to plants: is it a form of equivocation and multivocity (the same term, like “intelligence”, is used in a totally different way), homonymy (plants are intelligent in the same way as animals in part, and humans, are) or analogy (the same term is used in different interconnected ways for different beings)? Authors take position, in order to create a reading contract with the reader.

This situation reminds us of another difficult semantic problem, the one of European Christian medieval scholars in front of God: “How can we speak about a transcendent, totally simple spiritual being without altering the sense of the words we use?” (Ashworth et al. 2017, 1). This discussion led to the flourishing of different visions of analogy. A similar situation appears today in the case of plants, given their “otherness”. As Tassin writes in the foreword, “Plant nature, though omnipresent in our environment, is invisible to us. We have given it many names and identified some of its own mechanisms, but we hardly know what it is [...]”. This author uses the image of a long trip, needed to get in touch with plants: “And we'll have to walk a long way, out of our bearings. Then, huddled against its sidewalk, the plant will perhaps finally reveal to us, free from its veil, its true face”. Analogy and the image of initiation trip (present also in the foreword of Mancuso and Viola) are very old rhetorical tools, used to talk about transcendence, which are now used to develop the narrative of plants intelligence.

Different metalinguistic strategies are used. Mancuso and Viola use rhetorical questions and the rhetorical *topos* of definition (managing the meaning to make an argument acceptable): “How can we deny their intelligence under these conditions? In the final analysis, it is all a matter of terminology and everything depends on the meaning that is given to this word: [...] we will see that it can be understood as the “capacity to solve problems”, and we will see that if we retain this definition, plants even reveal a brilliant intelligence in the choice of solutions to adopt in order to face the difficulties linked to their own existence” (empl. 88, foreword). Michel Thellier, a researcher interviewed in the issue of *Science & Vie*, uses the *topos* of

comparison affirming that “It seems no more shocking to me to talk about memory for a plant than for a computer” (52).

Other authors are more cautious, like Chamovitz and Tassin. In the prologue, Chamovitz asks for the permission of the reader: “Even if it is of course impossible to equate the functioning of plants with human behavior, I would nevertheless ask you to allow me to use, throughout the book, a vocabulary generally reserved for human experiences” (foreword, p. 5). This kind of humble sentences (a sort of “*captatio benevolentiae*”) is aimed at opening a space for change without creating a tension with the established linguistic habits. Chamovitz often uses concessive forms (“even if...”), as a tool to manage polyphony and the co-presence of different types of discourses. It is a different move than the Mancuso and Viola’s one: these last authors are much more directly attacking what they represent as “prejudices and dominant ideas” (empl. 52).

These examples show that differences exist concerning the intentionalist discourse, metalinguistic strategies and the polemic intensity. For Chamovitz the intentionalist (anthropomorphic) language has a lower status as a (metaphorical) medium of expression, while for Mancuso and Viola it is a rhetorical tool for revealing truth, even if definitions have to be adapted, like in the case of intelligence. All these rhetorical metalinguistic maneuvers and tricks, together with the visual features (acceleration, close-up and animation) testify the semiotic tensions created by polyphony and semantic innovation concerning plants intelligence and sensitivity.

5. Plants, humans and other animals: ontological tensions

The media productions analyzed in the previous section can be seen as a mirror of a new way in which the dominant Western culture perceives and, *in fine*, relates to plants. How do the results of this research concerning plants in media culture show new forms of relationships (Baluska & Mancuso, 2020), or even an ontological transformation? How does the regime of naturalism defined by Philippe Descola (Descola, 2005, 2021), the very one that attributes only to the human an interiority (that is to say, a consciousness, a soul, in short, an interior activity, defined in different ways in different cultural contexts), is questioned and challenged? This attribution of interiority, traditionally reserved to humans (and partly animals), to plants reconfigures the categorization of plants as “bodies-actants” (in the sense of bodies having an autonomous power to act, see 5.1), and is still highly disputed. We are now going to develop these semantic and ontological changes, basing in particular on books and other publications

included in our corpus, but also on the writings of some other researchers that have contributed to the development of these themes.

5.1. Plants as bodies-actants

Discussing the perception of plants and the new way of qualifying them (in Western societies, and here in particular in France) invites questions about: how to know the unknown? How do plants acquire the status of intelligent beings, or at least, cognitive beings? How does this research reconfigure the human/plant collective?

The sociology of actor-networks (SAR) highlights the notion of "actant", because it integrates both humans and non-humans into an "active collective" (Callon, 2006, online). It emphasizes "the capacity of each entity, especially non-human entities, to act or interact in a specific way with other humans and non-humans" (*Ibid.*, our translation). To this end, the notion of "actant" is fundamental to highlight the active nature of the entities that make up a networked collective:

"Non-humans act, and the researchers who establish themselves as spokespersons for these entities tell us what they can do and what they are willing to do. [...] The notion of a society made of humans is replaced by that of a collective produced by humans and non-humans" (Callon, *op. cit.*, our translation).

According to A.-J. Greimas and J. Courtés (semioticians active in France in the 20th century), the actant is seen as an entity that assumes a "certain number of roles" (Greimas, Courtés, 1993, pp. 3-5). It is defined by its "modal investment" (*Ibid.*): this means that an entity, as an actant-subject, is endowed with modalities: a will-to-do, a know-how, a power-to-do, or a duty-to-do. In this way, this entity acquires a modal "competence", which is a prerequisite for an (intentional) performance.

Let us recall that traditionally plants have been granted a utilitarian (and culturally anchored) function in the fields of agriculture, amenity, depollution, construction, heating or in the production of oxygen through photosynthesis. This allows them to obtain the status of actant. But in the light of the work of Ph. Descola (2005, 2021) concerning Western "naturalism", plants are endowed only with "physicality": they are characterized by their physico-chemical properties that allow us to feed on them, to heal ourselves, to get pleasure from them, etc. Consequently, they can only perform as actants at this level (that of physicality).

But, as we have seen previously, for several decades, academic research has attributed to plants capacities that are traditionally attributed only to humans or possibly to certain animal species, such as the ability to learn, memorize, and communicate (Calvo, Keijzer, 2009; Gagliano *et al.*, 2012; Trewavas, 2016; Tassin, 2016; Chamovitz, 2018; Calvo *et al.*, 2020; Parise *et al.*, 2020). We can describe this change as the attribution to plants of a "form" (an essential identity) that includes interiority: this attribution is made through the application of an "intentionalist" lexical field of human and animal origin (see section 4; Descola, 2005; Cholet, 2021). This attribution enriches the actantial status of plants, that is, their roles in the relations they maintain with other actants, especially humans; it also weakens the classical separation between human as a subject and vegetal nature as passive, dominated and commodified object.

The "physical presence" of plants, endowed with a certain energy, is traditionally undisputed in terms of physicality, but it is much more so in terms of interiority (Dortier 2021, Burgat, 2020, Mallatt *et al.*, 2021, Robinson *et al.*, 2020). This new valuation of plants, via a new semantic qualification and the endowment of an interior form and intentionality, upsets the perception we have of them, inherited from the Aristotelian and - especially - Cartesian (mechanistic) vision. Linguistic and visual constructions analyzed above (section 4) are the expression of the tensions created in media culture by this change.

5.2. A new semantic constitution of plants

For the past few decades, to apprehend the "inner" forms of plants, researchers have been describing them from their "senses", *i.e.*, from hearing, touch, sight, smell, and taste, and from mental faculties (memory, learning, and will). For example, for T. Trewavas, plants make "decisions that balance [their] well-being with [their] environment" from their senses (Trewavas, 2016, p. 549). Biologist S. Mancuso considers plant photoreceptors as "primitive eyes" (Mancuso, Viola, 2018). D. Chamovitz, meanwhile, writes that plants "see us" (Chamovitz, 2018). From their perception of light, they are informed of our presence, or that of any other living being around. Plants would also be gifted with tactile sensitivity. While touch is allowed in humans by multiple receptors, of which there is no known equivalent in plants, this does not prevent them from reacting to even the lightest "tactile stimuli" (Tassin, 2016).

All these aspects put in evidence that plants are much more complex than previously believed, and support the attribution of a status of actants also on the level of interiority, in a similar way to humans and other animals (Trewavas, 2016; Segundo-Ortin, Calvo, 2021). This

plant interiority is drawn from the multitude of behaviors observed in the plant world and defined by these authors as "intelligence", *i.e.*, capacities related to communication, sociability, memory, proprioception, anticipation, cooperation, mutual aid and even (some form of) consciousness. This multitude of observed behaviors presented itself until then as an "unconstituted" reality that had to be named, in order to anchor them in manageable semantic categories.

This new semantic "constitution" renovates, according to us, the way of apprehending plants, but also the regime of identification in which this form of apprehension is situated, Naturalism (Descola, 2005, 2021). But before coming to the ontological level, we wish to underline the process of grasping and interpreting the plant at work, the one that follows the act of perception, and by which a certain number of researchers defend plants as body-actors endowed with an interiority (through the mentions of intelligence or consciousness).

The major difference between the authors advocating elaborate cognitive activity in plants and those advocating only automatic reactions seems to lie in the process of "iconization" (Bordron, 2011), that is, in the conceptual stabilization of the observations made on plants' behaviors and reactions. This process can lead to affirming or denying the existence, behind the observed phenomena, of an interiority of plants: in this sense it involves a conceptual stabilization of the phenomenological experience of the interiority of plants. This process is essential in our eyes to advance the hypothesis of an ontological transformation.

5.3. Transformation of Naturalism: "interior" forms to be stabilized

Naturally, to affirm that plants are intelligent, or even conscious, everything depends on what we attribute to these terms, but even more on the process of conceptual stabilization of the experience of observing plants ("iconization" in Bordron's words), an intermediary moment between the perception of an entity and the putting of the latter into words or into an image. We therefore distinguish several levels of study to address the ontological change concerning plants: (i) a perceptive and sensitive level (seeing and experiencing the plant and its behavior), (ii) a level of conceptualization/ideation of entities according to a process of apprehension of the world (the semantic process of interpretation of the experience), and finally, (iii) a linguistic level, written or visual, which corresponds to a level of manifestation of the accomplished

semantic process (discourses and media on “plants’ intelligence)⁴. Together, they constitute the process of “iconization” and invite discussion of the ontological dimension. We focus in particular on (ii) and (iii).

Concerning the linguistic level (iii), we have seen that a semantic debate with metadiscursive “tricks” is being played out to examine this unknown and far from fully explored world (see section 4). This one also opens a reflection on the problematic of the unknown and the otherness, its qualification, in connection with the advances and the discoveries made on the plants. The authors mentioned here, such as S. Mancuso, A. Trevawas, M. Gagliano, D. Chamovitz, or J. Tassin, use the same lexical fields as those used to talk about humans and other animals, supported by visuals, to consider the world of plants (their “inner” forms), underlining, however, their profound otherness with the animal kingdom (an “intentionalist” language combined with the effect of “spectacular othering”). Plants “see”, but not like mammals that have two eyes each; they hear, but not like beings with a pair of ears, etc. This goes against other authors (Dortier, 2020; Burgat, 2020, Mallatt et al., 2021, Robinson et al., 2020) who seek to nuance the claims about plant intelligence. For example, J.-F. Dortier considers that affirming that plants are intelligent poses a “risk” of creating “confusion”. One could no longer delimit “neither its forms nor its degrees” (Dortier, 2020). To the term of “intelligence”, the author prefers that of “adaptation”; to that of “perception”, he prefers that of “sensation”; to that of “memory”, he prefers the term of “elementary habituation”. Everything would be a matter of degrees and nuances. This linguistic posture distances the animal kingdom from the plant kingdom (at least concerning their interior forms). These examples show well that the description of plant cognition, poorly known and still to be discovered, poses terminological problems, similar to the ones of discourses on God (see section 4). How can we overcome this semantic difficulty? Should we use vocabulary and categories that are already known, often connoted and axiologized, or should we invent new ones? In the end, what language posture should be adopted?

Another level of study on plant cognition interests us here. It corresponds to the conceptual stabilization of perceptual experience (ii). As already said, it can be discussed on the basis of J.-F. Bordron's theory of iconicity (2011), that draws on the writings of I. Kant (in particular, the *Critique of Pure Reason*, 1787, and the *Critique of Judgment*, 1790), but also on

⁴ Bordron (2011) connects these three levels to the three types of signs proposed by the philosopher Charles S. Peirce in his semiotic theory: respectively, index, icon and symbol.

C. S. Peirce's triadic approach. The media productions studied here are the results of a "genesis" where "something becomes iconic" (Bordron, 2011, online). This brings into question the established categorical boundaries. From this perspective, the authors in favor of a vision of the plants as endowed with cognition seem to base on "indexical data" (what is perceived through senses) that take the form of "substances or flows" (Ibid.), and they try to conceptualize them. They seek to describe, to put in form qualities without making immediate reference to the human model of intelligence. Notions such as intelligence, communication or memory would no longer be the prerogative of the human as a model: the semantic system in place is thus "reopened" to change its configuration, by going beyond well-established hierarchies. This change in the ideal apprehension of biological entities would explain the adoption of a semantic categorization of the plant world that takes up categories traditionally linked to the human. The question is no longer to know who has the right to have the mention "intelligent", or not, in reference to the human. It is rather to explore the different forms of "intelligence", in which the human is only one actantial entity among others, with all the diversity that this term (intelligence) can cover today. In this perspective, the movements and behaviors of plants observed in scientific experiments (and by field experts such as Peter Wohlleben) make it possible to attribute to plants a semantic content that is new compared to traditional structures.

This process of iconization, defined as "compositional" by Bordron (2011), implies the conversion of the perceptive experiences of the entities of the world (plants) into signs starting from the identification of "flows and forces" (such as the capacity to communicate, to memorize, etc.) that enrich their identity. The body-actant "plant" is metamorphosed: its form is enriched by an interior dimension. Let us add that, to adjust to this new extension of the actant "plant", the process of iconization puts under tension notions such as intelligence, which becomes practically coextensive to the living being as a whole. Following the words of M. Gagliano, the human must no longer constitute the prototype of a cognitive activity:

"[C]ommunication should not be held as a 'property' of an organism, but rather as a dynamic 'process' of interaction within the organism/environment system." (Gagliano, 2018, our translation).

The iconization process is no longer based on a prototype or model (the human to embody intelligence), but in the perspective of a world made up of interacting (sentient) forms. It is up to the researcher or expert to show how this set of interacting entities takes "form, stability and consistency" in order to be organized "into a symbolic system" of language

(Bordron, 2011, online). We have seen that the media productions studied here take up existing modes of categorization, which are usually attributed to humans and to certain animal species (intelligence, sensitivity), and attribute them to plants. This way of apprehending and knowing the living makes these categories more complex (a plant is intelligent and communicate in a different way), and allows to compare entities from the point of view of cognition, thus opening towards a stronger ontological continuity between humans and non-humans (plants in this case).

As shown in the previous paragraphs, the process of iconization as the stabilization of an apprehension of the world allows to articulate the levels of perception, ideation (conceptual stabilization) and language. These considerations lead us then towards an additional level of study concerning ontological order. It invites us to question the postures of Western industrialized societies towards non-humans, which are being shaken, at the age of the biodiversity crisis (IPBES, 2019). The study of the iconization process allows us to point out and apprehend the new forms of interaction and ethics based on a shared interiority between humans and non-humans. Our research seems to confirm a tendency towards a renewal of Naturalism (Descola, 2005, 2021) by fully opening the semantic category of interiority to plants. This renewal starts from the very phase of apprehension of the entity "plant", because the media productions studied here above are the result of a mode of apprehension of sensible data concerning plants other than the one based on a model (the human being). This creates an ontological reorganization between the humans and the other living, and the apparition of a sort of "post-naturalism". This renewed exploration of the plant world takes the human being out of his relative isolation. Intelligence and capacities such as those of communication or memorization are no longer reserved to the latter (and to certain animal species): they become more inclusive and articulated into different variations, opening up new questions concerning the qualification of what is specifically human.

Conclusions, limitations and future research. Towards a "new naturalism"?

This article proposed a trip in three steps. The first one was a quantitative assessment of the "media push" of contents concerning plants, and plant intelligence and sensitivity in particular, taking place in France between 2014 and 2020. This assessment was based on the constitution of a multimedia corpus made mainly of books and magazine issues. The second stage consisted in a qualitative, inductive observation of a section of this corpus, and it led to

the identification of some specific semiotic devices linked to the staging of the intelligence and sensitivity of plants: in particular, acceleration, close-up, and animation concerning the visual, and analogy, an “intentionalist” type of discourse, and specific metalinguistic strategies concerning the verbal. The third stage was a more theoretical observation of the semantic “work” that is implied in the new narrative of plant intelligence and sensitivity, and its implications for the Western vision of plants. The Western traditional (modern) naturalistic attribution of “interiority” (in the sense of Descola) only to humans (and in part some animals) is put into tension, as the attribution of interiority to plants is proposed and staged (but also discussed). Western naturalism is questioned and its ontological structure is shaken: a sort of “post-naturalism”, or new naturalism, seems to appear.

Through this study, which deserves to be continued, we can see the complexity of addressing the emergence of new actants, with "inner" forms, such as plants, and the multiple implications of these changes. Interdisciplinarity is a necessity for further exploration and understanding of the plant as an actant (with inner and outer forms). Let us observe that the human and social sciences are quite relevant to feed this discussion and to extend it, with the exploration of the effects of the evolution of Western naturalism on the perception of the human being and its place in the world of the living. This evolution has also important ethical implications, and many authors have already explored the notion of a “more-than-human ethics” (see for ex. Cañada, Sariola & Butcher 2022), even if much more should be done concerning the exploration of interactions between humans and other living beings in the era of the Anthropocene.

Let us add that this research has its limitations: on the one hand, it focuses on a short period of time and concerns only one, European, country; on the other hand, we focus only on a limited sub-corpus for (i) the qualitative observation of verbal and visual features concerning plants, and (ii) for the final discussion. Further research is needed to analyze the relations of Western societies to plants, with other corpora, other approaches, in other parts of the world.

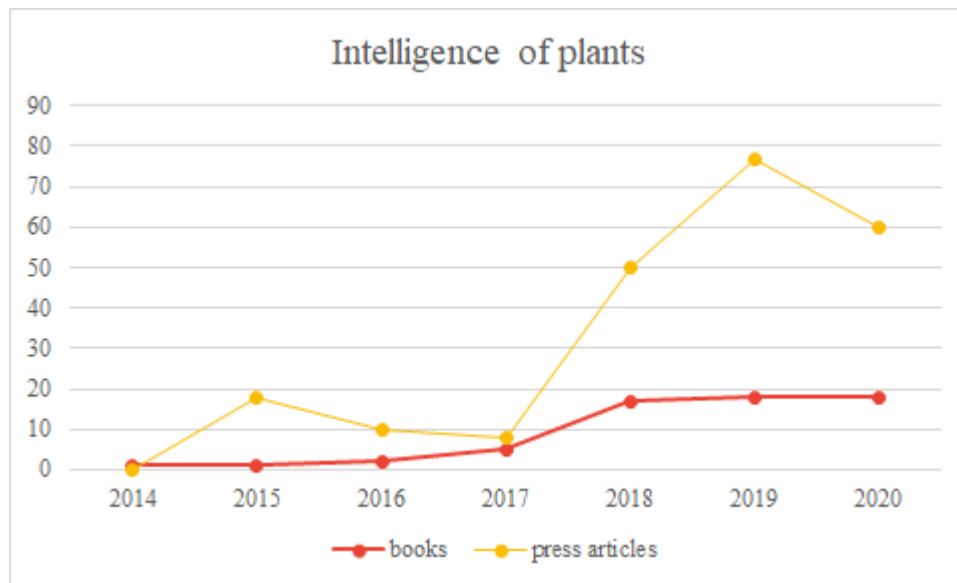
References

Ashworth, E. Jennifer & Domenic D’Ettore (2021). “Medieval Theories of Analogy”, *The Stanford Encyclopedia of Philosophy* (Winter 2021 Edition), Edward N. Zalta (ed.).

- Backster, C., Fumey, B., Collin, J., Laszlo, E., & Choquet, M. (2015). *L'intelligence émotionnelle des plantes*. Les éditions Trédaniel.
- Baluška, F., & Mancuso, S. (2020). "Plants, climate and humans: Plant intelligence changes everything". *EMBO Reports*, 21(3), e50109. <https://doi.org/10.15252/embr.202050109>
- Barthes, R. (1975), *The Pleasure of the Text*, Hill and Wang: New York.
- Barthes R. (1977). *Image—Music—Text* (1977), Hill and Wang: New York.
- Bordron J.-F. (2011). *L'iconicité et ses images. Études sémiotiques*, Paris, PUF.
- Burgat, F. (2020). *Qu'est-ce qu'une plante ? Essai sur la vie végétale*, Paris, Seuil.
- Callon, M. (2006). « Sociologie de l'acteur-réseau » in Callon M., Latour B., Akrich M. (dir.), *Sociologie de la traduction : textes fondateurs*, Nouvelle édition, Paris, Presses des Mines.
- Calvo, P., & Keijzer, F. A. (2009). Cognition in plants. *Plant-Environment Interactions: Behavioral Perspective*.
- Calvo, P., Gagliano, M., Souza, G. M., & Trewavas, A. (2020;2019;). Plants are intelligent, here's how. *Annals of Botany*, 125(1), 11-28. <https://doi.org/10.1093/aob/mcz155>
- Cañada JA, Sariola S, Butcher A. In critique of anthropocentrism: a more-than-human ethical framework for antimicrobial resistance. *Med Humanit*. 2022 Dec;48(4):e16. doi:10.1136/medhum-2021-012309.
- Catellani, A. (2022). Semiotic analysis of environmental communication campaigns. In: Gisela Gonçalves, Evandro Oliveira, *The Routledge Handbook of Nonprofit Communication*, Routledge: New York and London, p. 224-234. doi:10.4324/9781003170563.
- Chamovitz, D. (2018). *La plante et ses sens*. Buchet Chastel.
- Cholet C. (2021). « Renouveler l'image de soi en étudiant les plantes et leurs sens », Manes-Gallo Maria Caterina (dir.), *Image de soi – Image de l'autre*, Paris, Hermann.
- Chung, J. H., Sarmiento, I. G., Van Swol, L. M., Shaw, B. R., Koshollek, A., & Ahn, P. H. (2020). Promoting reforestation to landowners: The role of advice-giving through information, efficacy, narratives, and identification in storytelling. *Journal of Forestry*, 118(5), 474-486. <https://doi.org/10.1093/jofore/fvaa028>
- Cvrčková, F., Lipavská, H., & Žárský, V. (2009). Plant intelligence: Why, why not or where? *Plant Signaling & Behavior*, 4(5), 394-399. <https://doi.org/10.4161/psb.4.5.8276>
- Coccia, E. (2016). *La Vie des plantes. Une métaphysique du mélange*, Paris, Payot et Rivages.
- Daugey, F. (2018). *L'intelligence des plantes*. Ulmer.
- Descola P. (2005), *Par-delà nature et culture*, Paris, Gallimard.
- Descola P. (2021), *Les formes du visible. Une anthropologie de la figuration*, Paris, éd. du Seuil.

- Farcy, C., Martinez de Arano, I., & Rojas-Briales, E. (2018). *Forestry in the midst of global changes*. CRC PRESS.
- Faucher, K. (2014). Phytosemiotics revisited: Botanical behavior and sign transduction. *Semiotica*, 2014(202), 673–688. <https://doi.org/10.1515/sem-2014-0053>
- Gagliano, M. (2015;2014;). In a green frame of mind: Perspectives on the behavioural ecology and cognitive nature of plants. *AoB Plants*, 7(1). <https://doi.org/10.1093/aobpla/plu075>
- Gagliano, M., Mancuso, S., & Robert, D. (2012). Towards understanding plant bioacoustics. *Trends in plant science*, 17(6), 323-325.
- Greimas, A. J., Courtès, J. (1979-1993). *Sémiotique. Dictionnaire raisonné de la théorie du langage*, Paris, Hachette supérieur. English version: *Semiotics and Language: An Analytical Dictionary*. Translated by Larry Christ, Daniel Patte, James Lee, Edward McMahonII, Gary Phillips, & Michael Rengstorf. Bloomington, IN: Indiana University Press, 1983.
- Hébert, L. (2020). *An Introduction to Applied Semiotics: tools for Text and Image*. Routledge. <http://www.signosemio.com/documents/Louis-Hebert-Tools-for-Texts-and-Images.pdf>
- Hendlin, Y. H. (2022;2021). Plant philosophy and interpretation: Making sense of contemporary plant intelligence debates. *Environmental Values*, 31(3), 253-276. <https://doi.org/10.3197/096327121X16141642287755>
- Hiernaux et Timmermans (éds.) (2019). *Philosophie du végétal*, Paris, Vrin.
- Korhonen, E., Toppinen, A., Lähtinen, K., Ranacher, L., Werner, A., Stern, T., & Kutnar, A. (2016). Communicating forest sector sustainability: Results from four european countries. *Forest Products Journal*, 66(5-6), 362-370. <https://doi.org/10.13073/FPJ-D-15-00046>
- Kull K., 2000, An introduction to phytosemiotics: Semiotic botany and vegetative sign systems, *Sign Systems Studies*, 28, 326-350. <https://doi.org/10.12697/SSS.2000.28.18>
- IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. <https://doi.org/10.5281/zenodo.3831673>
- Lawrence, A. M. (2022; 2021). Listening to plants: Conversations between critical plant studies and vegetal geography. *Progress in Human Geography*, 46(2), 629-651. <https://doi.org/10.1177/03091325211062167>
- Mallatt, J., Blatt, M. R., Draguhn, A., Robinson, D. G., & Taiz, L. (2021). Debunking a myth: Plant consciousness. *Protoplasma*, 258(3), 459-476. <https://doi.org/10.1007/s00709-020-01579-w>

- Mancuso, S., & Viola, A. (2018). *L'intelligence des plantes*. Albin Michel (Italian version 2013).
- Parise, A. G., Gagliano, M., & Souza, G. M. (2020). Extended cognition in plants: is it possible?. *Plant signaling & behavior*, 15(2), 1710661.
- Pelt, J. M., & Steffan, F. (2014). *Les langages secrets de la nature: la communication chez les animaux et les plantes*. Fayard.
- Pollan, M. (2001). *The Botany of Desire*. Random House.
- Robinson, D. G., Draguhn, A., & Taiz, L. (2020). Plant “intelligence” changes nothing. *EMBO Reports*, 21(5), e50395-n/a. <https://doi.org/10.15252/embr.202050395>
- Segundo-Ortin, M., & Calvo, P. (2022). Consciousness and cognition in plants. *Wiley Interdisciplinary Reviews. Cognitive Science*, 13(2), n/a. <https://doi.org/10.1002/wcs.1578>
- Tassin, J. (2016). *À quoi pensent les plantes?* Odile Jacob.
- Tassin, J. (2018). *Penser comme un arbre*. Odile Jacob.
- Trewavas, A. (2003). Aspects of plant intelligence. *Annals of Botany*, 92(1), 1-20. <https://doi.org/10.1093/aob/mcg101>
- Trewavas, T. (2016). Plant intelligence: An overview. *Bioscience*, 66(7), 542-551. <https://doi.org/10.1093/biosci/biw048>
- Van Cauwelaert, D., & Clerc, L. (2018). *Les émotions cachées des plantes*. Plon.
- Wohlleben P. (2018), *L'horloge de la Nature*, Macro, Le Fil Vert.
- Wohlleben, P. (2017). *La vie secrète des arbres*. Éditions des Arènes, Paris, France.





Marin
Crawford



Peter
Wohlleben



Eduardo
Khon



Vlantine
Plessy



Fig. 1: quantitative evolution of publications on the intelligence and sensitivity of plants between 2014 and 2020.

Fig 2: major bestsellers books published in France in 2017.

fig. 3. A still from the documentary “L’intelligence des arbres”.