



**BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD**

**MITOS BOTÂNICOS: FAKE NEWS DO MUNDO CONTEMPORÂNEO**

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**ABSTRACT**

The myths take many forms depending on the cultures in which we find them; however, their function is always to explain natural phenomena that occur in their surroundings. As observed throughout human history, it is an inherent condition for the human species to believe in the metaphysical and to use their individual, and introspective thinking as a way to achieve their dreams and goals; something that works as a responsible 'driving force' in many cases, for governing and inspiring the human individual. Additionally, populations or part of communities that obtain their livelihood and/or subsistence directly from agricultural activity spontaneously express a greater willingness to believe in the 'infallible' agroforestry myths, which explain the possible botanical phenomena. In light of this, our present study lists the main physiological bases refuting different botanical myths based on evidence proven in original articles. Furthermore, our phenomenological approach was carried out in an eclectic way in the field of botany and is not linked to any specific authority or philosophical school. Finally, we explore and integrate different, mutually compatible approaches to provide the reader with a global understanding of the 'infallibility' of botanical myths.

**KEYWORDS:** Agroforestry myths. Human thoughts. Infallibility. Plant physiology. Scientific evidence.

**RESUMO**

Os mitos assumem muitas formas, dependendo das culturas em que os encontramos; entretanto, sua função é sempre explicar os fenômenos naturais que ocorrem em seu entorno. Conforme observado ao longo da história humana, trata-se de uma condição inerente para a espécie humana acreditar na metafísica e usar seu pensamento individual e introspectivo como forma de alcançar seus sonhos e objetivos, algo que funciona como uma 'força-motriz' responsável em muitos casos por governar e inspirar o indivíduo humano. Além disso, populações ou parte de comunidades que obtêm/obtiveram seu sustento e/ou subsistência diretamente da atividade agrícola expressam espontaneamente uma maior disposição em acreditar nos mitos agroflorestais 'infalíveis', que explicam os possíveis fenômenos botânicos. Diante disso, nosso presente estudo lista as principais bases fisiológicas que refutam diferentes mitos botânicos com base em evidências comprovadas em artigos originais. Além disso, nossa abordagem fenomenológica foi realizada de forma eclética no campo da botânica e não está vinculada a nenhuma autoridade ou escola filosófica específica. Finalmente, exploramos e integramos abordagens diferentes e mutuamente compatíveis para fornecer ao leitor uma compreensão global da "infalibilidade" dos mitos botânicos.

**PALAVRAS-CHAVE:** Mitos agroflorestais. Pensamento humano. Infalibilidade. Fisiologia vegetal. Evidência científica.

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### INTRODUCTION

Often, our smartphones, social networks and mailboxes are flooded with information from entertainment, self-knowledge, miraculous food supplements, and sighting of flying saucers and aliens that lived in the past among us. Furthermore, this information avalanche, for the most part, does not present scientific evidence (ZHANG; GHORBANI, 2020).

Since ancient times, humanity has relentlessly sought to understand and justify the natural phenomena observed in its environment. Among the countless situations that our ancestors experienced, in a world completely different from the reality we know today, the observation of the development of plants was routine, as their survival depended mainly on subsistence cultivation (SCHAAL, 2019).

In general, people who presented some stage of their life linked to rural life, or even those who inherited information from their ancestors about plants, possibly incorporated or developed some of the so-called 'infallible dogmas' that the success, or failure, in propagating plants, flowering or death of plants are linked to the belief that there is some metaphysical factor, or even, something like the 'strength' of human thought that governs or commands different physiological effects in plant individuals (SOEJARTO; ADDO; KINGHORN, 2019).

Based on the premises previously exposed, our present study aims to shed light on the main botanical bases on the physiological metabolism of plant species to refute different botanic myths, based on evidence proven in scientific publications. We will present the empirical justifications that explain the observed phenomena and refute the belief that the 'Man' with his 'thought' is responsible for the occurrence of natural phenomena.

### ORIGIN OF BOTANIC MYTHS

For millennia, humanity has had a natural tendency to 'believe what you want to believe'. The limitation of the mind is a natural prisoner that reduces the understanding of reality (PILATI, 2018). This same author reports that mental limitations easily lead us to believe in explanations that are distant from reality and we 'insist' on believing, especially in 'infallible' belief systems. On the other hand, science and technology, whose main feature is its 'fallible' character, are flawed. Historically, mythological oral transmissions are fantastic tales with origin and circulation within a given community, since human beings have always had the innate need to explain and understand what they have just seen or experienced. In the ancient world, myths existed to express 'essential truths' that, in a practical sense, many people today would call the gospel (PETIŠKA, 2000).

The word "myth" is derived from the Greek "mythos", which means "history", which allows us to state that 'mythology' refers to a set of stories, often with a naive and simplified interpretation of the world and its origin (MERKUR, 2015). Ultimately, mythology represents the experience of mystical union or direct communion of the observed experience with reality. Myths are not scientific or sociological theories about these issues and are the result of the way a nation or group has pondered these big questions. In the West, the search for facts of science is similar to the search for facts of history; however, both differ from the search for religious experience in the present (FAWKES, 2017). At 525 BC, Teágenes classified myths as



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analogies or scientific allegories to explain phenomena of nature that people could not understand. These 'scientific' myths sought to explain the development of plant species, flowering, fruit formation, and the death of plants. Undoubtedly, the creation of myths and their use in daily life has always been one of the most common human endeavors (Table 1).

**Table 1.** Compilation of the main gods related to agriculture and soil fertility.

Mythological god	Civilization
Frey	Nordic
Ceres	Greek
Demeter	Roman
Osiris	Egyptian
Sucellus	Celtic / Galician
Chac	Mayan
Tupã	'Tupi' / 'Guarani' / 'Ianomami'
Shennong	Chinese

Historically, during the 'new world' colonization process, for example, in Brazil, the religion and beliefs of the different native tribes, which existed there, were replaced and merged in a process of religious syncretism with the beliefs of the colonizers. Basically, the values of belief and religiosity were gradually incorporated directly and indirectly into the daily lives of the population that gradually adjusted to the social changes that were taking place there, which certainly provided an 'environment' for the mix of popular beliefs were the best language to interpret the phenomena of nature (DROOGERS, 2015).

Specifically, in Brazil, they report that native Indians had beliefs that explain the origin of several species, and these myths are transferred to the present day. These indigenous beliefs can awaken the sympathy and interest of children and young people in plants, for example, the history of the emergence of guarana plants (*Paullinia cupana* Kunth.) and the amazon water-lily [*Victoria amazonica* (Poepp.) J.C. Sowerby] (SALATINO; BUCKERIDGE, 2016). For example, in the myth about the amazon water lily, the similarity between the organography of the flower to the 'imagined' shape of a star is implicit. The guarana fruit is based on the similarity between the human eye and the black seed with the typical white aryl.

### PROBABILITY OF MATERIALIZATION OF 'HUMAN THINKING' IN PLANTS



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Probability is the basis of statistics and is closely related to science; however, mysticism is a field full of vague definitions words. While classical science believed in the immutability of natural laws (ABRAHAM, 2015), the growth of modern science occurred thanks to the advancement of statistical knowledge, as we daily discern issues such as the efficiency of medicines and the popularity of politicians through statistical reasoning that is useful both in science and in everyday life (MLODINOW, 2009). In general, the scientific method is not dissociated from the probability, and the individual who appropriately appropriates the scientific method can claim legitimate results that protect him from individual idiosyncrasies (COOKE; SHRADER-FRECHETTE, 1991).

Normally, the human mind tends to identify causes for an event without accepting the influence of random or unrelated factors; however, valuing probability helps in understanding the experimental design and interpreting the results, since mathematics is a field that depends on words, signs, and symbols with precise definitions (GOTELLI; ELLISON, 2016). Furthermore, mathematics acts in the field of certainties, and probability acts in the field of uncertainties, which allows the understanding of complex phenomena from the variations that occur in different fields of knowledge (BLITZSTEIN; HWANG, 2019).

Undoubtedly, our society is currently in an evident technological advance that increasingly enables the realization of numerous commitments and meetings, which multiply in 'geometric progression', however with ever shorter deadlines, which requires physics and psychologically more and more human beings. Certainly, these elements, added to unhealthy habits and little time for introspection, are responsible for a range of stresses (TAMS; AHUJA; THATCHER; GROVER, 2020), and these stressful events are often associated with a feeling of "bad luck" in the face of some difficulty (wrong choices in personal relationships, financial losses, failure in a personal or professional company, etc.) that re often beyond your control (known terminology) as fortune, in Latin, that is, it associates with 'non-rational' points. For example, if a person goes through a bad period in his life and gets a four-leaf-clover (*Oxalis deppei* lodd.) and, later, his life starts to improve, the subconscious associates that improvement with the plant. So, what happens is the combination of factors, probabilistic, which are associated with the presence of the plant ('totem') having 'mystical' properties when it proves favorable and permissible in the face of your beliefs (ZANINI, 2009).

Currently, there is an endless supply of communication channels among the population, such as blogs, instant messengers, television programs, and websites that have little concern for scientific veracity when disseminating information that has previously been rigorously tested and scientific method disseminating, to 'stride' and deliberately, information without scientific proof, the so-called fake news (ALDWAIRI; ALWAHEDI, 2018). The belief that, often, 'thought power' and other homocentric beliefs can deliberately 'modulate' the physiological effects on plants is, unfortunately, reproduced and disseminated as an 'absolute and indisputable' (infallible) truth, dogmatic, something like 'if you want that to happen, just want to and mentalize' applicable to Eukarya domain (plant species are categorized in this nomenclature).



### **'TALKING WITH THE PLANTS' STIMULATES PLANT DEVELOPMENT**

One of the main news that is most popular among plant lovers is the strong belief that 'talking' with plants results in healthy, vigorous plants, flowering and even 'rejuvenates' plant individuals. Undoubtedly, people's contact with plants, whether visiting parks, walking through tree-lined streets, or even the hobby of growing plants, is something salutary, a sensory experience that conveys a pleasant feeling, greater comfort, and more mental relaxation purchased from those who have completed a technology-related task (LIU; WANG; LU; LI et al., 2020). The myth of inferring that the conversation between human beings and plants brings benefits to the latter may even seem sympathetic, at first, however, there are no robust and sufficient scientific foundations to validate the myth itself, with wide physiological results published in textbooks in the field of plant physiology.

Plants are sessile organisms that are subject to the environment, thus responding to stimuli such as, the action of waves, whether they are electromagnetic or mechanical (FERNANDEZ-JARAMILLO; DUARTE-GALVAN; GARCIA-MIER; JIMENEZ-GARCIA et al., 2018). Electromagnetic waves have many benefits for plants, such as light, which is responsible for providing energy to reduce carbon in an organic molecule (BARON; AMARO; CAMPOS; FERREIRA, 2018); however, excessive light can cause damage to plants, being even harmful to the photosynthetic process, since too much light destroys the photosynthetic pigments, chlorophyll, leaving the leaves white or even burned, thus causing photoinhibition (THOMAS; ANJA, 2014).

Mechanical waves other than electromagnetic waves need a physical medium for their propagation, which generates vibration and pressure in the material, mechanisms responsible for wave transmission (MOURAILLE; LUDING, 2008). However, to observe the influence of a mechanical wave on metabolic processes, it is necessary to use specific frequencies that can be maintained for periods, which is very difficult, if not impossible, to be performed during a conversation between a human and the plant. Exposure frequencies and time are important, as they generate acoustic clues about their environments through disturbances caused in the plasma membrane, which trigger hyperpolarization of the plasma membrane that allows rapid  $Ca^{2+}$  ion entrance, and temporary accumulation in the cytoplasm (RODRIGO-MORENO et al., 2017). Thus, the rapid accumulation of calcium and the output of potassium generate a signal that marks the direction of growth, which is in the direction of the stimulus.

Biologically, sounds are especially important for the communication of various living beings. In particular, plants are capable of producing sound waves resulting from cavitation when exposed to water deficit with the emission of sound from their vascular tissue (GAGLIANO; MANCUSO; ROBERT, 2012), however, these same authors claim that the sound emission is dispersed, also emitted by plants that do not respond to water stress or cavitation, which denotes that this capacity for bioacoustic detection is linked to its sensory system and its interactions with the environment. The reaction of the touch-me-not plants (*Impatiens walleriana* Hook.f.) before the emission of the sounds of the cicada (*Quesada gigas* Olivier) caused an increase in its photosynthetic rate; however, when the sound of the cicadas presented itself in a disorganized way, there was no gain in the



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Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

photosynthetic rate (CYPRIANO, 2013). The same authors state that the physiological response to the perception of an environmental sound will depend on the stage of development of the plant and the sound organization emitted by the source. Additionally, the vibrations propagated by the act of chewing the leaves performed by caterpillars of the small cabbage butterfly (*Pieris rapae* L.) are recognized and distinguished from other sounds by the species *Arabidopsis thaliana* (APPEL; COCROFT, 2014).

Plants of the species *Marcgravia evenia* Krug & Urb are responsive to sound stimuli emitted by bats due to the concave shape of their leaves, allowing greater accessibility for pollinating bats (SIMON; HOLDERIED; KOCH; VON HELVERSEN, 2011). These results assume that plant development is coordinated by an integrated network that involves signaling, communication, and a response system. Research involving 'neurobiology in plants' shows that plants are organisms endowed with 'intelligence', as they have the ability to react and make decisions in the face of adversity faced in the environment in which they live (TREWAVAS, 2003). For some authors, the intelligence of plants is related to their ability to process information from vascular tissues, such as phloem and xylem, act in a similar way to 'neurons' while transmitting and receiving electrical, molecular, and hydraulic information from all parts of the plant (BALUŠKA; VOLKMANN; HLAVACKA; MANCUSO et al., 2006). However, the sonority that exists in nature does not necessarily mean a communication or 'conversation' between natural entities and between them and humans, being, therefore, the dialogue between humans and plants, an act of ventriloquism, because the world is a deafening place and we humans may not notice all these communications and interactions that occur (INGOLD, 2013). Therefore, these analyses do not necessarily imply an evident manifestation of communication with the human being itself but rather a form of circumstantial reaction by the plant.

In this way, all the myths reported and the ones we have and had contacts with, so far, that is the one that the presence of the human is necessary for the plant to benefit, but not for addressing the plant and uttering sounds, gestures, thoughts, but by dedicating 'manual' care and, consequently, less aggressive to the environment, which will favor your survival (WHITEHEAD; MACLEOD; CAMPBELL, 2020). It is considered that every individual plant, regardless of the species to which it belongs, when receiving luminosity (hours of light and hours of darkness), essential mineral elements, irrigation, temperature, and relative air humidity will ensure that the plant expresses its physiological potential and completes its life cycle (TAIZ; ZEIGER; MØLLER; MURPHY, 2015).

If the plant is injured by insect pests or diseases, naturally, some plant individuals grown in different 'homes' tolerate a non-severe attack; however, its vigor and visual aspects tend to expose some symptoms, e.g., change in leaf color, cutouts, or holes in the leaf blade, necrotic scores, etc. From then on, it is quite reasonable for lovers and plant owners to worry about these first signs and try, with reason, to mitigate the signs, using their own hands to clean and remove necrotic leaves, insect pests or apply natural products for pathogen control, among other cultural treatments (ANDRADE; NUNES, 2001).



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The myth hypothesizes that when talking directly with the plant, this action will help the plant to tolerate and overcome pathogenicity. When talking close to the plant, inevitably, the owner, visually, will observe this plant more carefully and remove dry/old leaves, sucking and masticator insects, irrigating the growing substrate in the vase or flower bed. When performing manual care, plant development will be favorable, and consequently, it will express its physiological potential. To date, there are still some assertions without sufficient scientific basement that human expiration, close to the plant, favors the concentration of inorganic carbon in the substomatal chamber and, consequently, improvements in photosynthetic rates. In an assumption that the concentration of CO<sub>2</sub> in the substomatal chamber occurs because of the 'talking' of the human close to the plant, the literature indicates that accumulation of carbon implies less efficiency of the Ribulose 1,5-Biphosphate Carboxylase Oxygenase enzyme (RuBisCO), directly responsible for accomplishment of the Calvin/Benson cycle, in which organic compound is synthesized. Thus, the increase in the concentration of CO<sub>2</sub> in the substomatal chamber will result in a bad effect on the plant, with contradictions, diametrically, the justification presented by the myth (GALMÉS; CAPÓ-BAUÇÀ; NIINEMETS; IÑIGUEZ, 2019).

The most important enzymatic reaction to support the existence of life-based carbon on our planet, as we know, is because of the enzymatic metabolism accomplished by RuBisCO (UDENIGWE; OKOLIE; QIAN; OHANENYE et al., 2017). This intricate and delicate biochemical mechanism for obtaining atmospheric carbon has very remote origins and evolved in the last 450 million years, a long time before the existence of the first ancestor in common with the human species (NISBET; GRASSINEAU; HOWE; ABELL et al., 2007). In this sense, the natural environment with the presence of humanity was present relatively recently, approximately 2.5 million years ago, from the evolution of the genus Homo in the African continent (HARARI, 2015), which shows the dependence of humanity on plants, and not the other way around, for plants to obtain the carbon necessary for their metabolism.

Therefore, the benefits that humanity, in the home environment, can provide to plants are restricted to techniques and management of cultivation, empirical, and observable strategies. These conditions are extremely different from the myth that "intentionality of thoughts" through conversation/CO<sub>2</sub> expiration, directed at the plant, will bring benefits to plant growth and development.

### **'GREEN FINGERS' TO MAKE SEEDLINGS**

Probably, dear reader, this is the most widespread and popularized myth of human imagination about the propagation and cultivation of plants. Widely disseminated in the most different social classes, from formal environments of university or basic teaching (classrooms, libraries, amphitheater, etc.), as well as in familiar environments, public squares and several other places, it has become common to hear something like *'I don't have green fingers to plant and I am unlucky for gardening'* *'John Doe or Jane Doe has a green finger to grow plants'*, etc...



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Independent of the mental and/or psychiatric clinical condition of people (schizophrenia, hallucinations, etc.), because there are several times where medical help is needed (PARNAS; HENRIKSEN, 2016) for clinical conditions of low self-esteem and depression, realities increasingly present in the global population, the scientific community considers that the attributes 'luck' or 'bad luck' in the plant growing no way determines the success/failure in the growing so that luck is merely a consequence of random (probability of occurrence), something external to any human individual (MALTBY; DAY; GILL; COLLEY et al., 2008).

Throughout the Neolithic Revolution, human beings made the transition from their mode of social organization, in which nomadic societies became more sedentary and, as a consequence, there was the development of agriculture with the growth of food, medicinal or ornamental plant species in certain places (RULL, 2020). Therefore, species of easy propagation were 'artificially' selected by humans, although the principles that the 'natural selection of the most adapted/apt' corroborate the selection that existed at that time. Even more impressive is that this 'artificial' selection process by man is in full use, either to the predilection of a plant species in a remote native tribe or the mass selection technique accomplished by researchers in their equipped research laboratories (HARARI, 2015). However, the myth is easily refuted by the scientific community when we explore, for example, the morpho-physiological bases involved in the plant propagation process. Basically, plants can use 2 different ways of propagation: (i) seminiferous propagation or sexual propagation and (ii) vegetative propagation or asexual propagation (BARON; ESTEVES AMARO; PINA; FERREIRA, 2019; OZIAS-AKINS; CONNER, 2020).

Seminiferous propagation, also known as sexual propagation, is the most efficient strategy for the dissemination and perpetuation of species from an evolutionary point of view because it provides an exchange of genetic material between male and female parents, originating individuals with a high degree of parentage; however, the plants propagated by this technique have genetic material that is different from their parents (LAMA; KLEMOLA; SALONIEMI; NIEMELÄ et al., 2018). The male reproductive floral structure described as 'pollen bags' (diploid cells) produces pollen grains (male gametophyte), which carries the sporophyte, and this, when germinating on the female reproductive floral structure, described as 'stigma', produces a pollen tube along from the stylet that transports the germ nuclei/sperm nucleus (haploid cell) until reaching the embryonic sac (female gametophyte), in which one of these haploid nuclei merges with the oosphere (haploid cell) giving rise to the zygote (diploid cell) (KIM; ZHANG; JUNG, 2019).

Vegetative or asexual propagation, in which there is no exchange of genetic material, will give rise to clonal descendants of their parents (HARTMANN; KESTER; DAVIES, 2011). From an evolutionary point of view, this propagative strategy does not give descendants genetic variability, a sine qua non characteristic as a 'driving force' that boosted the emergence of modern species to dominate the terrestrial surface environment of our planet (DAHL; ARENS, 2020). Also, vegetative propagation is observed under natural conditions or artificially induced for economic purposes in which there is some edaphoclimatic limitation that does not favor overcoming the quiescence and/or



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dormancy of reproductive diaspores via seminiferous. The propagation of a plant with attractive characteristics (e.g., organoleptic quality of the fruit) from its 'cloning' will guarantee identical characteristics between the 'matrix plant' and its descendants.

Therefore, it is quite justifiable that a large part of our society wants to propagate plants by this technique, either on a commercial scale or on a household scale. Among many plant species historically 'propagated', on a household scale, there are those of ornamental and/or nutritional interest and/or medicine and/or edible weeds. For example, rose-bushes (*Rosa* spp.), hibiscus (*Hibiscus* spp.), geranium (*Pelargonium* spp.), basil (*Ocimum* spp.), mint (*Mentha* spp.), spur flowers (*Plectranthus* spp.), nasturtium flower (*Tropaeolum* spp.), purslane (*Portulaca* spp.), onion and garlic (*Allium* spp.), etc. (Table 2).

**Table 2.** Most popular household plant species.

Common name	Scientific name	Propagation technique	Plant parts	Common use	Reference
Dollar-princess	<i>Fuchsia x hybrida</i> 'Swingtime'	Herbaceous cutting	stem	Ornamental	(Wróblewska 2013)
Torch-glory	<i>Bougainvillea</i> spp.	Bindweed cutting	stem	Ornamental	(Kobayashi et al. 2007)
Camellia	<i>Camelia</i> spp.	Semi-woody cutting	stem	Ornamental	(Lima et al. 2011)
Kalanchoe	<i>Kalanchoe</i> spp.	Cutting	leaf	Ornamental	(Smith et al. 2019)
African-Violet	<i>Saintpaulia</i> spp.	Cutting	leaf	Ornamental	(Kimmins 1992)
Touch-me-not	<i>Impatiens</i> spp.	Layering	stem	Ornamental	(Schmitz and Dericks 2010)
Tibouchina	<i>Tibouchina fothersgillae</i> (D.C.) Cogn.	Air layering	stem	Ornamental	(Cézar et al. 2009)
Rose-bushes	<i>Rosa</i> spp.	Grafting	stem	Ornamental	(Van De Pol and Breukelaar 1982)

However, there are many other species in which vegetative propagation requires a higher degree of technical knowledge, for example, the most suitable time of year, specific cutting (stem) diameter and/or region of the parent plant for collection, substrate, and adequate water volume for the 'fixation' of the seedling. It is evident that the lack of technical knowledge and/or lack of manual skill in plant propagation become important factors that contribute to the failure of propagation (HARTMANN; KESTER; DAVIES, 2011) and not, necessarily, to the factors 'luck' or 'bad luck'. Pedrinho and



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collaborators (PEDRINHO; LOPES; PIZETTA; CASALLI et al., 2003) reported that the rose has a lower percentage of rooting during the winter (between June and September in the Southern Hemisphere); nevertheless, there is a small percentage of chance (probability) in obtaining a plant individual resulting from this technique.

If the cutting preparation is carried out at the right time (spring season), it is not a question of 'luck', but the execution of a methodological protocol at the right time. Then, if the human individual correctly executes the protocol at the recommended time but does not achieve the expected/desired success, there is no "bad luck" factor at cuttings, but rather, that there is something technical not correctly adopted, for example, the choice of cuttings with the wrong diameter thickness, rooting substrate, etc. (MONDER; KOZAKIEWICZ; JANKOWSKA, 2019). Another justification between several concepts described in the literature that elucidate cutting rooting refers to anatomical factors.

According to Hartmann and collaborators (HARTMANN; KESTER; DAVIES, 2011), plant species with easy cuttings rooting show discontinuous sclerenchymatous cell layers, which facilitate the projection of roots in a centrifugal direction, originating from the totipotent cells present in the pericycle and, consequently, there will be a greater chance of cuttings rooting. However, species with difficult rooting present continuous sclerenchymatous cell layers, which makes it difficult to project the roots in a centrifugal direction, and thus, the chances of rooting of the cuttings become remote. In view of the above technical arguments, the non-implementation of methodological protocols will generate less chance of success in plant propagation, which refutes the myth that there is 'luck or bad luck'.

### 'EVIL EYE' ON THE PEPPER PLANT

Several plant species in Brazil are popularly known as pepper plants, and these different individuals are described as domesticated, semi-domesticated, or wild species. The pepper species considered domesticated belong to the botanical genus *Capsicum* (from the Greek 'kapso', which means 'burning' or 'spicy'), such as chili-pepper (*Capsicum frutescens* L.), bishop's-crown-pepper (*Capsicum baccatum* Wild.), and lemon-drop-pepper (*Capsicum chinense* Jacq.), classified as heliophytes, shrubs, and annuals with a production cycle between 150 and 365 days (CARVALHO; BIANCHETTI, 2008). Moreover, these same authors also report that the origin center of species occurs in the American continent, with the center of diversity of chili-pepper between Southeastern Brazil to Central America and the Antilles, in the Caribbean. The bishop's-crown-pepper species includes countries in the northwest of South America, such as Bolivia (greater diversity), Colombia, Ecuador, Peru and in the South and Southeast regions of Brazil, and the lemon-drop-pepper, native to the Amazon Basin, the most popular and 'Brazilian' among the pepper plants used in Brazil.

The food interest of these species is because of the metabolic characteristics of pungency (ADASZEK; GADOMSKA; MAZUREK; ŁYP et al., 2019) that evolved in nature to serve the plant itself in repelling herbivorous predation, an ecological phenomenon known as targeted dissuasion. The fruit is characterized as a berry, deciduous or persistent that produces capsaicinoid metabolites



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BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

(metabolite 'capsaicin' promotes pungency) belonging to the class of secondary metabolites of alkaloids, naturally biosynthesized in epidermal cells (YALDIZ; OZGUVEN; SEKEROGLU, 2010), which present food flavoring, natural repellent and sacred rituals (DE SMET, 1985). In addition to the application of pepper for culinary purposes, there was always an appreciation from the population for a belief that it would bring benefits in the treatment of hemorrhoids (GUPTA, 2008). However, these beliefs are not confirmed by the scientific community, as patients with hemorrhoids are advised to avoid foods with the potential to irritate such as peppers, coffees, colas, and spices (OHNING; MACHICADO; JENSEN, 2009); that is, their consumption is not recommended for patients with anal fissures because pepper seems to aggravate the condition of patients with acute anal fissures (ulcers).

The agroforestry myth about pepper cultivated near or inside their homes, or even carrying personal amulet objects shaped like the pepper fruit, will represent something like a "filter" or even a "lightning rod", for 'bad' thoughts or feelings of 'envy' by passers-by or close to believer and, why not, people belong the family, or even as a way of 'immunize the material possessions' that are important to the believer. Thus, if the plant 'to dry' or 'death', after the situation occurs, immediately believers in the myth associate this phenological event with the fact that the plant 'captured' these bad thoughts', causing its death.

Historically, it is perfectly understandable that humanity has sought conscious and unconscious explanations to understand the nature around them (HEINÄMAA; LÄHTEENMÄKI; REMES, 2007). This situation becomes even more intriguing when we imagine, for example, one vigorous plant individual at a present moment and, later on, the same plant individual shows signs of decline that, in some cases, to death. There is sufficient scientific evidence to affirm that plants are vigorous and healthy in favorable environmental conditions, whether these are abiotic factors (photoperiod, temperature, water regime, mineral nutrition) (TENENBOIM; BROTMAN, 2016) or biotic factors (cell circadian rhythm, gene expression) (SRIVASTAVA; SHAMIM; KUMAR; MISHRA et al., 2019).

There are many passive approaches already documented in the literature to refute the myth, for example, the necessity for the pepper plant to require a tenuous adjustment of water potential in the soil, somewhere between -0.01 to -0.07 MPa (GUTIÉRREZ-GÓMEZ; CARRILLO-AVILA; LANDEROS-SÁNCHEZ; COH-MÉNDEZ et al., 2018). This means that if the hydric availability in the soil oscillates, until some values of the water potential, the plant will be able to absorb water from the soil solution and balance its cellular osmotic adjustment while keeping alive. If the water availability in this same soil reaches lower than adequate hydric potential values, the plant will not be able to absorb water, and even if the volume of water is restored to the soil, it will not be possible to invigorate the plant (LARCHER; HUBER-SANNWALD; WIESER, 2003).

Another very pertinent example to the theme is the life cycle of pepper species, as they are plants that have a relatively short life cycle, and it is natural for the plant to enter senescence and death (IPGRI, 1995). Complementing, even the natural and constant alternation of climatic seasons



## RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR ISSN 2675-6218

BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

throughout the year can be a trigger for an annual cycle plant to start its senescence and death, since if the plant species were sown and/or transplanted to the place it received solar light in this occasion (for example, 16h of light per day) and, with the progress of time, the initially luminous region does not receive the adequate amount of daylight (or hours of darkness, if applicable!), this stressful situation will certainly contribute to the death of the plant (RODRÍGUEZ-CALZADA; QIAN; STRID; NEUGART et al., 2019).

In this sense, it is important to highlight that these stresses caused by water deficit, insufficiency, or excess daylight cause the formation of signaling molecules such as reactive oxygen species (ROS), which in low concentrations and in a transient way are fundamental for the maintenance of plant life; however, severe events can lead to a rapid accumulation of these reactive molecules so that the defense systems are enzymatic and nonenzymatic, which leads to the death of the plant. Therefore, it is evident that plant development and survival are the results of a myriad of genomic, nutritional, and hormonal factors that must occur together (WANG; CIMEN; SINGH; BUCKLER, 2020). The simplest imbalance in this 'fine-tuning' of factors will be enough for the withered leaves, regardless of the human presence or absence of surroundings.

### FLOWERING OF PLANT SPECIES CONDITIONED TO 'RELIGIOUS SCHEDULE'

The *Tibouchina candolleane* (DC.) Cogn (Melastomataceae) species, popularly known as *quaresmeira* ('lent'), is a plant pioneer perennial angiosperm spontaneously (native) in the rainforest on the Atlantic hillside, and routinely, this species is used in landscape and urban arborization projects (LORENZI, 2013). It is a woody-plant with effusive production of purple corolla flowers, arranged in terminal and axillary panicles with the production of reproductive structures in two seasons a year, in june-august and december-march months, whereas the flowering in this last season gains greater prominence due to the greater presence of pollinators that are attracted by the colour of the petals and their fragrance (PEREIRA; DA SILVA; GOLDENBERG; MELO et al., 2011).

The popular myth about this plant species is, exactly, in its popular name '*quaresmeira*' (lent), which occurs, coincidentally, because this tree species flourishes effusively during the time of the year that in Brazil, the largest Roman Catholic country in the planet in numbers absolutes, professes one of his main religious liturgies (between march-april months). In Catholic liturgy, the celebration of Lent represents a period of penance, reflection, and miracle of the Christian faith (HERTELIU; RICHMOND; ROEHNER, 2019). Given the importance of this liturgy to the Catholic faith, it is possible to find believers who infer that the flowering of this plant tree and all other plant species, by one 'divine entity', is something like a 'sign' that marks the beginning of this religious rite. However, scientific studies report that angiosperms follow a delicate and dramatic metabolic balance between phenological stages of plant development and climatic conditions (TAIZ; ZEIGER; MØLLER; MURPHY, 2015), in other words, independent of religious and/or civil calendars.

In general, there are few studies that investigate physiological mechanisms of flowering with the use of plant species not considered 'model plants'. Thus, the scientific results obtained from the



## RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR ISSN 2675-6218

BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

investigation of plant species are well elucidated, for example, rice (*Oryza sativa* L.) and arabidopsis (*Arabidopsis thaliana* L.) are extrapolated to countless other species, including many other native species (WANG; YAN; ZHOU; CHENG et al., 2019). Plant species that require a minimum and critical period of daylight hours for floral induction are considered 'long-day plants' and only flower if the darkness is shorter than a critical period (LOPEZ; MENG; RUNKLE, 2020). The physiological mechanisms involved in the floral stimulus of the species require the succession of the seasons, which is considered the most constant environmental factor on the planet, and the chemical signals carried by the phloemic conduit with qualitative or mandatory responses regarding the abiotic factors environmental (TAOKA; OHKI; TSUJI; FURUITA et al., 2011).

According to Wickland and Hanzawa (WICKLAND; HANZAWA, 2015), many interconnected metabolic pathways coordinate the flowering time with the environmental contribution to optimizing the plant's adaptation to its reproductive success. Additionally, two important genes downstream of these flowering pathways are *Flowering Locus T (FT)* and *Terminal Flor 1 (TFL1)* (IGASAKI; WATANABE; NISHIGUCHI; KOTODA, 2008). The duration of hours of daylight and darkness (photoperiod), included in the period before the flowering time, is considered the primary trigger for the expression of *FT* transcripts (mRNA) in an optional long-day plant, for example, arabidopsis. In this way, the *FT* gene facilitates the transition to flowering in response to its induction by the *CONSTANS* transcription factor (*CO*) (SUÁREZ-LÓPEZ; WHEATLEY; ROBSON; ONOUCHI et al., 2001), where this gene is regulated by the circadian clock and tightly controlled at the transcriptional and posttranscriptional levels by the interaction of multiple transcription factors and photoreceptors (ANDRÉS; COUPLAND, 2012). Thus, the *CO* gene reaches the peak of long photoperiods at the end of the day, when it reaches sufficient levels to promote *TFL1* expression in the leaves (VALVERDE, 2011).

Other environmental factors, in addition to the photoperiod, also modulate the expression of the *TFL1* gene, for example, temperature, which targets the *FT* promoter or non-coding regions, such as the *Like Heterochromatin Protein 1 (LHP1)* and the *Flowering Locus C* gene (*FLC*) (ADRIAN; FARRONA; REIMER; ALBANI et al., 2010). After *CO* induction, the *FT* protein moves from the leaves through the phloem to the stem apical meristem (NOTAGUCHI; ABE; KIMURA; DAIMON et al., 2008) and in this way induces the transition to flowering (YANOVSKY; KAY, 2003). In summary, plant organisms are unaware of their existence or any other of their physiological mechanisms (TAIZ; ALKON; DRAGUHN; MURPHY et al., 2019), neither do they regulate one of its most dramatic stages (flowering) through human belief and thoughts.

### EUCALYPTUS PLANTS UPTAKE WATER MORE 'THAN ITSELF NEEDS'

Approximately 750 species belong to the botanical genus *Eucalyptus* (Myrtaceae). These individuals are perennial plant angiosperms and heliophytes, and the overwhelming majority of species are endemic to Australia, a place traditionally accepted for being the main center of dispersion of the genus (POTTS; PEDERICK, 2000). *Eucalyptus* plants are the most widely cultivated plant wood and represent an important source of biomass for the production of fuels, chemicals, and materials. Its



## RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR ISSN 2675-6218

BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

industrial benefit can be achieved by processes following the biorefinery concept, which is based on the selective fractionation of the main components (hemicelluloses, cellulose, and lignin) (LOAIZA; ALFARO; LÓPEZ; GARCÍA et al., 2020).

In the popular myth about *Eucalyptus* plants, there is a strong indication that these species are 'voracious' consumers of water, using it indiscriminately, from the observation that water bodies and water reservoirs are suddenly exhausted when these tree plant individuals are grown in nearby locations. Most likely, in this myth, what people observe is the effect of inadequate management and without technical agronomic-forestry criteria (TAVARES; BEIROZ; FIALHO; FRAZÃO et al., 2019) because the cultivation of these plants in permanent preservation areas is prohibited and protected by federal laws in Brazil (CUNHA; BÖRNER; WUNDER; COSENZA et al., 2016), and not exactly the cause. Scientific articles in forestry expertise indicate plant individuals belonging to the genus *Eucalyptus* that can reach between 60 and 100 meters in height (SILLETT; VAN PELT; KRAMER; CARROLL et al., 2015), with individual water demand common to organisms of this size.

The scientific literature reported that the plant species obtains more than 95% of all its plant demand by employing the radicles located in contact with the soil solution from the movement of water through the continuum or soil-plant-atmosphere system (KIRKHAM, 2014). Through movements of the guard cells that form the stomatal complex, plants can regulate water losses through transpiration; that is, the most pronounced water potential gradient develops between the almost saturated stoma and the atmosphere (MANZONI; VICO; PORPORATO; KATUL, 2013). Besides, there is scientific evidence that *Eucalyptus*, as a 'pioneer plant' (ecological succession), is indicated as an alternative for the recovery of degraded areas, as it allows the accumulation of litter and the development of the understory under the canopy of trees. Also, there is the additional hydrological benefit that individuals belonging to the botanical genus *Eucalyptus* are indicated in the initial recovery of a mixed forest ecosystem, for example, agroforestry systems (CHU; OUYANG; LIAO; ZHOU et al., 2019; DAGAR; LAL; RAM; KUMAR et al., 2016).

The literature indicates that approximately 98% of the total volume of water absorbed by the root structures is transpired into the atmosphere by the aerial part of the plants, and the rest is used in photosynthetic processes (approximately 1.5%) and other metabolic processes (0.5%). The production of 1 g of dry matter, the plant needs to transpire the impressive volume of 1 to 1.5 L of water (TAIZ; ZEIGER; MØLLER; MURPHY, 2015), which results for some tree species (for example, *Eucalyptus* spp.) the incredible mark of 3200 L. transpired at 24 hours (OUYANG; XU; LEININGER; ZHANG, 2016). Thus, the total use of water in *Eucalyptus* plantations, Morris, and collaborators (MORRIS; NINGNAN; ZENGJIANG; COLLOPY et al., 2004) report that this cultivation demands a total rainfall volume of 550 L.m<sup>-2</sup> year<sup>-1</sup>.

When extrapolating to an agricultural scenario of grains and cereals, for example, Brazil, it is estimated that to produce 250.9 million tons of grains in the 2019/2020 cycle (CONAB, 2020), this value specifically refers to the grain mass with moisture (approximately 10 to 15% v / v), and the wet mass is removed (dry matter value) only after drying the grains at 65°C at 72h (BENINCASA, 2003).



## RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR ISSN 2675-6218

BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

Thus, although we can be impressed with the absolute numbers presented, the volume of water transpired by a single individual is essential for the physiological mechanisms to occur, for example, transport mineral elements, mRNA, and small peptides towards the aerial part (SALISBURY; ROSS, 2012). The selection of genotypes that combine high biomass production, high water use efficiency (WUE), and adequate wood properties is a major challenge for the improvement of tree species with commercial interest. Additionally, there are encouraging results for the selection of *Eucalyptus* varieties adapted to dry areas, maintaining good performances concerning other economic characteristics of interest (BOUVET; MAKOUANZI EKOMONO; BRENDEL; LACLAU et al., 2020).

Thus, there is no indiscriminate water use by the plant itself. What often occurs is the technical management of production in inadequate environmental areas and/or with a very high number of individuals per ha (LIU; WU; FAN; DUAN et al., 2017). Thus, in no way, each plant individual will consume more water than it needs for its survival.

### EXCEPTIONALITIES AND PRELIMINARY STUDIES

At this point, dear reader, perhaps your landlady will ask:

- "... but what if myths occur?"
- "... and if I witness some of these myths, what is the meaning?"

Faced with these possible and intriguing natural occurrences, mathematics indicates that, regardless of the observed phenomena, there is a minimal probability that the referred myth has occurred in the way it is postulated and this is due to random phenomenological factors and not, precisely, by the motivation of the myth itself. For example, the variability of the genetic makeup of some plant individuals can give rise to results that coincide with 'human' actions and 'human thoughts' and convey the feeling that the 'materialization' of the expected phenomenon (myth) is something orchestrated by simple will human.

### FINAL CONSIDERATIONS

Our study politely approached, throughout its argumentation, the deep respect and understanding of the different creeds and faiths that deal with botanical myths. Additionally, we respect all points of view, whether supported by scientific publications or not, and reiterate our commitment to writing this review article based on reproducible and publicized scientific evidence in the specialized scientific literature.

As noted, throughout human history, it is an inherent condition for the human species to believe in the metaphysical and use their individual and introspective thinking as a way to 'materialize' their dreams and goals, something that works as a 'driving force' responsible, in many cases, responsible for governing and animating the human individual. The interpretation of the natural world around us requires, from each of us, an examination of conscience when facing the dilemma between living in the uncertainty of what we know or living with the certainty of something that can be mistaken. In the end, but not least, information corroborated or not corroborated by the scientific literature,



## RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR ISSN 2675-6218

BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
Daniel Baron, Carlos Gustavo Momberg da Silva, Felipe Giroto Campos

disseminated among different social media and on the most different possible topics that are presented to us daily, yet it is up to each of us '*all we have to decide is what to do with the time that is given us*' (TOLKIEN, 2012).

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**RECIMA21 - REVISTA CIENTÍFICA MULTIDISCIPLINAR**  
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BOTANICAL MYTHS: FAKE NEWS OF THE CONTEMPORARY WORLD  
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