

# Chaos, Order and Complexity in Plant Behavior, and Communication ; Language of Plants and Network through Roots; Photon Entanglement producing Order from Chaos ; The formation of Consciousness and memory in Plants

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**Abstract:-** Since the advent of Darwin, we have generally thought of trees as striving, isolated entities competing for water, nutrients and sunlight with the victor obliterating the losers. Many humans, especially those in the timber industry, view forests as wood - producing systems. At present, there is an emerging body of qualified scientific evidence that challenges the above idea. They provide proof that trees belonging to the same species are communal and frequently form alliances with other species.

Forest trees have evolved to thrive in cooperative, interdependent relationships maintained by communication and a collective intelligence similar to an a colony of ants .We are fascinated by the arboreal splendor above the soil but the action, communicative whispers , which pertain to a language conveyed by networks resembling neural connections all occur below the soil.

This paper investigates the process of entanglement in plants, as random light is transformed into entangled photons through Chaos and emerging Complexity and order. The role of entanglement in the production of electrical signals through the roots and fungal mycorrhizae for communication is analyzed. Furthermore, Chaos and order is investigated in the communication process which may produce a certain language for communication .

## I. INTRODUCTION

All trees, in every forest and park, are connected to each other through underground fungal networks . Water and nutrients are shared through these networks for communication.

Informative distress signals about drought and disease, say, due to insect attacks are sent by tree, causing other trees to change their behavior and establish security , once they receive their messages.

The above mentioned networks are termed mycorrhizal networks. The fundamental links of the network are formed from the root tips of trees which are fine and hairlike and which join together with microscopic fungal filaments. The combination operates as a symbiotic relationship between trees and fungi. The latter, as a beneficiary of their services, consume approximately 30% of the sugar photosynthesized by the trees from sunlight. The sugar acts as food and fuel fungi to scavenge nitrogen from the soil.

Communication through the network are performed by slow-pushing electric signals which are chemical and hormonal, sent by the trees. Scientists are now beginning to decipher the language of communication and have even discovered a fair amount of vocabulary.. Electrical pulses studied by Ewart Farmer at the University of Lausanne in Switzerland identify a signaling system . The signals are strikingly similar to neuron systems of animals , although further research is necessary to confirm that plants possess brains.Furthermore, although it is believed that alarm and distress are the main types of communication. Many scientists are of the opinion that trees converse on mother topics and may even express some emotional behavior.

Communication through the air is also achieved by trees with the help of pheromones and other scent signals.

Trees are also able to detect scents through their leaves, which qualifies as a sense of smell.They also have a sense of taste. For with his hands example, when leaf-eating caterpillars attack trees such as elms and pines, they detect the caterpillar saliva and release pheromones which are able to attract parasitic wasps, which arrive and lay eggs inside the caterpillars. The caterpillars are consumed completely by the wasp larvae.

Research at Leipzig University and the German Center for Integrative Biodiversity Research reveals that trees know the taste of deer saliva. When a deer eats a branch, the tree senses it and sends defending chemicals to that area to make the leaves taste bad. If a branch is broken by a human with his/her hands, the tree senses the difference and sends substances to heal the wound.

The mycorrhizal networks with vast fungal connections even play a nurturing, supporting, maternal role. With their deep roots, they draw up water which, with nutrients, are made available to shallow rooted seedlings. They assist neighboring trees by sending them nutrients, when neighboring mother trees are struggling, and the latter trees detect their distress signals and accordingly increase the flow of nutrients.

Related pairs of trees recognize the root tips of their kins amidst the root tips of unrelated trees and seem to favor them.

The Ongoing research on trees and their mycorrhizal networks manifest an intricate and holistic behavior beyond the simplistic competition and Darwinism survival of the fittest species.

## II. CHAOS AND ORDER IN MYCORRHIZAL NETWORKS AND PLANT COMMUNICATION

All living beings, including plants, are systems which are thermodynamically dissipative. They also possess properties which are self organized and emergent and often exhibit nonlinear dynamics that can fit to deterministic Chaos. Many biological phenomena experience chaotic dynamics, such as human EEG, different processes in plant Physiology, and ecological dynamics, to name a few. It has been shown that the time oriented dynamics is highly complex, yet not random and primarily chaotic.

The question arises then, as to what could engender such Complexity? Plants do not possess a nervous system; they do have a complex network of ion fluxes which move through definite cell types, transmitting information between various and distant cell sites within the organism. Chaos and Complexity thus can provide a distinct means of communication within the the plant and its root network. There is possibly a physiological meaning in the chaotic behavior.

A plant's signaling network consists of different types of signals, such as hormones, ROS, Ca<sup>2+</sup> and electric signals. Electric signals in plants are of three types: APs (action potentials), VPs (variation potentials) and SPs (system potentials). These signals play major roles in cell to cell and long distance communication in plants.

The Complexity of the massive ionic flow through plant tissues could be similar to the Complexity in the human brain, which also is subject to the Chaos, Complexity and order in plant species. Both are, as a consequence, responsible for

communication. Whether plant communication is capable of speech in certain aspects has not been conclusively proved yet, but analogs to the human brain and its neural networks occur in the mycorrhizal networks of Plants.

Furthermore, communication possibly occurs at the quantum level, involving quantum Chaos and Complexity and is certainly connected to another phenomenon known as quantum entanglement.

## III. QUANTUM ENTANGLEMENT AS A RESULT OF CHAOS AND ORDER AND THE ROLE OF ENTANGLEMENT IN PLANT COMMUNICATION.

Quantum Entanglement can be used for communication by taking advantage of the unique correlations established by entangled qubits to create instantaneous agreements across very long distances.

There is a clear connection between chaos and entanglement in the quantum realm. A laser is an example of electric random light achieving Complexity and order as monochromatic laser light. [1] Similarly, in biological systems for example, plants, random rays of sunlight are entangled on a platform of protein molecules and are a major factor in photosynthesis.

Chaos has been generally considered in nature.

Entanglement occurs in the human brain via natural networks as a result of chaotic vibrations and have been cited as creators of consciousness. Plant neural networks occur below the soil and may be cited as the brain, when combined with the fungal network connections. Communication in plants thus arise as a result of such entanglement and electrical impulses bordering on the semblance of speech may be produced from an assembled consciousness which propagates and directs communication.. [2]

## IV. CLASSICAL CHAOS IN THE QUANTUM WORLD

In the world we experience with our senses, which is the world governed by the laws of classical physics, chaotic behavior is the rule and not an exception. Familiar cases involve the weather, chemical reactions, population dynamics, neural networks and even the stock market. [3]

Numerous experiments have revealed, however, that classical chaos spills into the quantum world.

Entanglement has been the new signature of Chaos in the quantum world. [4]

Entanglement is best known from a thought experiment by Albert Einstein, in which two light particles, or photons, are emitted with polarizations that are fundamentally undefined yet perfectly correlated. Later, suppose the photons travel apart in space and their polarizations are measured at the same instant in time. They are then found to be completely random but always at right angles to each other .

The concept of entanglement can be extended to a pair of particles or systems which have no independent parts.[5]

It has been estimated by theorists that the onset of Chaos increases the degree to which different parts of a quantum system are entangled.[6]

## V. ENTANGLEMENT AND PLANT CONSCIOUSNESS

Two fundamental components of Consciousness are microtubule function and electrical gamma ray synchrony. It has been found that both the above factors play an important role in the consciousness of plants .

It has been shown that quantum computing in plants is possible, due to the presence of quasicrystal structures composed of ribosomes that may enable quantum computing (quantum computing has been suggested as forming the basis for animal Consciousness). Furthermore, the presence of a microtubule fractal indicates that electric current plays a pivotal role in the neurocomputing process in plants..

Every organized being can be explained as Conscious .In plants , brains can be thought to lie in the roots. Swarm intelligence is developed in the mycorrhizal network connected to other trees of the same species .as well as others. However, the intelligence arising from Consciousness may be projected to every individual plant .[8] That is, individual intelligence is responsible for creating the swarm-like harmony and collective Consciousness. [9]

Quantum mechanics plays a vital role in the understanding of Consciousness [10]. Roger Penrose, mathematician and Nobel Laureate, has suggested that our lack of understanding of animal Consciousness arises from our lack of understanding of quantum mechanics. The same reasoning can be applied to plants.

Memory also plays a pivotal role in Consciousness . To be conscious of something at any time implies that information must be represented in the memory at that time. It is suggested that gamma synchrony and microtubules are instrumental in memory formation. The learning procedures in animals and in all probability, plants, are strongly influenced by MAPS( Microtubule Associated Proteins ).

Results of research has indicated that many plant microtubules can encode memories, just as in animals.

Higher level mental states are also dependent on gamma-ray synchrony. Studies have linked MAPS with gamma-ray synchrony in the formation of memory and Consciousness. Roger Penrose has suggested that quantum mechanics is responsible for the formation of quasicrystals.

Microtubules serve as biological wires that can transmit and amplify electrical signals via cohesive ion cloud flow. Intracellular information flow and electrical flow can be achieved through these microtubules. Plant microtubules behave similar to animal ones.

Electrical current seems to form the function of branched fractals.

Further study of Consciousness in animals will also result in the study of plant Consciousness as well. The pattern of Chaos raising the degree of entanglement and consequent formation of Consciousness exists in the animal world and can be extended to the world of plants.

## VI. CONCLUSION

This paper establishes Chaos and order as the driving force in quantum systems involving plant communication , producing entanglement, which moves electrical impulses through mycorrhizal networks in trees. That trees, through mutual connections between their own species and others is also investigated .

Distant parts of a quantum system, in plants or in animals are entangled , the degree of entanglement determined by the onset of Chaos. The paper also suggests that quantum entanglement may trigger Consciousness in plants as in animals, and consequent memory formation. There is, however, a significant amount of research to be performed in this area, as well as in plant communication.

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