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Bio-magnetism as a Mechanism Underlying the Processes Involved in Pollination

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Abstract

Pollination in flower bearing plants is the process of pollen transfer from the anther (male part of the flower) to the stigma (female part). This process enables fertilization and reproduction. In this report we demonstrate electromagnetic forces (EMFs) found in flowers of 5 different plants associated with the metabolic activity of these flower organs. We used a single slide preparation (SSP) on which different parts of Angiosperms plants reproductive organs parts and nocturnal animal pollinators were studied. Several drops of a solution containing nano-sized iron particles (Fe) and a Prussian Blue Stain (PBS) for iron were placed on the specimens. After the liquid dried, microphotographs and video recording were made of the patterns of crystallization of the PBS/Fe residue. Several examples are shown of evaporation induced crystal formation in the SSPs, which correlate with the electromagnetic fields (EMFs) of both the isolated living plants and insect parts. The EMFs triggered crystallization of non-animate small magnet fragments in a SSP is also presented as corroborative evidence that EMFs induce aggregate crystallization. Our results suggest that biomagnetism emanates from selective flower parts and in the presence of iron deposits in the antenna and joints of ant pollinators during the plant's reproductive cycle. The property of biomagnetism is hypothesized to play a signaling role in the attraction between flowers and pollinators.

Keywords

Biomagnetism, Pollination, Pollination Syndrome, Pollination Signalling

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1. Introduction

In this report we demonstrate electromagnetic forces (EMFs) found in flowers of 5 different plants associated with the metabolic activity of these flower organs. By using a novel and simplified method for imaging the electromagnetic energy in plants and animal tissue [1] we accomplished (for the first time) the recordings of the EMFs in a single slide preparation (SSP) on which different parts of Angiosperms plants reproductive organs parts and nocturnal animal pollinators were studied. The study results suggest that biomagnetism emanates from selective flower parts and in the presence of iron deposits in the antenna and joints of ant pollinators during the plant's reproductive cycle. The property of biomagnetism is hypothesized to play a signaling role in the attraction between flowers and pollinators.

Previously, we demonstrated that electromagnetic fields (EMFs) could be detected emanating from various biological material such rat whiskers, [2] human hairs [3] and from leaves of the mung bean plant (Vigna radiata, [4]. In all previous experiments, we demonstrated that an electromagnetic field (EMF) could be detected by the use of a solution of nano-sized iron particles mixed with a Prussian blue stain. The EMF generated by the biological material induced distinct images in evaporated paramagnetic solutions due to the magnetic properties of the aggregated iron particles.

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In the present study we extended these findings to other plant organs, specifically components of the flowers of different species and found that bio-magnetism detected by our nano-sized particle technique may play an important, yet unrecognized, role in the process of pollination in angiosperms.

2. Materials and Methods

2.1. Preparation of the Iron Containing Solution

A fine iron particle solution was prepared by mixing several grams of powdered iron filings (Edmond Scientific, Co., Tonawanda, NY) in 200 cc of deionized water (resistivity, 18.2 MΩ.cm). After standing for several hours the supernatant was carefully decanted for sizing of the iron nano-sized iron particles. The particle size and distribution of the nanoparticles from the supernatant was determined using dynamic light scattering (DLS) and the zeta potential using phase analysis light scattering by a Zeta potential analyzer (Zeta PALS, Brookhaven Instruments Corp, Holtsville, NY). For sizing, 1.5 ml of the solution in de-ionized water was scanned at 25°C and the values obtained in nanometers (nm). A similar aliquot of the fine iron particle solution was scanned for 25 runs at 25°C. for determining zeta potentials. Zeta potential values were displayed as millivolts (mV).

A paramagnetic solution was prepared as described below:

Solution Formula: One part of 2.5% Potassium Ferricyanide solution ($K_4Fe_3CN_6$) mixed with one part each of 2.5% HCl and two parts of the Fe 2000 iron containing solution. This resulted in a mixture with paramagnetic properties The salt contains the octahedrally coordinated $[Fe(CN)_6]^{3-}$ ion, abbreviated throughout the manuscript as “Fe3.”

2.2. The Single Slide Preparation (SSP): Control

One drop of the Fe3 solution from a transfer pipette was to a clean glass slide (25x75x1.0 mm) and allowed to undergo unimpeded evaporation at room temperature (75 F humidity 56%). This process was completed in an average time of 1 hour ± 15 minutes. When examined under a microscope, a field of small, randomly spaced crystals were observed and served as a control (Fig 1).

2.3. The Flower Parts SSP

The plant reproductive organs, of the flowers of different angiosperms species were examined. Small fragments (3 mm average) of the flower parts such as, stigma, pistils and petals were mounted on a clean glass slide and covered by the Fe3 solution. A total of 36 freshly harvested flowers from the Genus: *Jasminum, Hibiscus, Rosa, Vinca and Pentas* were studied. The flowers were harvested during sunny days, except the Jasminum that were also harvested at both day and nighttime when nocturnal pollinators were found and studied in a SSP Fe3 preparation. This was done in dry weather condition with an average daytime temperature of 89°F (31.6°C) and night time temperature of 76°F (24.4°C). The harvest took place during the first week of the month of June in South Florida, USA.

Ancillary testing: Magnet fragments

A rubberized flexible magnet fragment (3x3x1mm) was placed in a SSP. This time three drops of the Fe3 solution were placed covering the magnet. The wet field was allowed to evaporate and video recording and still microphotograph images were obtained. The purpose of this exercise was to demonstrate the association between electromagnetic forces (EMFs) and crystallization patterns (aggregations) of the paramagnetic (Fe3) crystals (Fig 2) By definition, paramagnetic materials exhibit magnetism when an external magnetic field is applied.

2.4. Recording Equipment

All SSPs of flower parts and controls were photographed after evaporation of the applied liquid. Still photos or videos were made in the at X4 magnification with a video microscope (Celestron LCD Digital Microscope II model #44341 Torrance California USA).

3. Results

The criteria used to ascertain the presence of EMFs was the triggering aggregation and direct adhesion of the paramagnetic crystals of $K_4Fe_3CN_6$ to the flower and pollinator parts. All plant species tested showed EMFs generating from the flower parts such as: Petals, Stamen (anther and filament), sepal and pistil (stigma, style). A similar phenomenon was observed in the pollinator’s antennae and legs. The qualitative data (images) demonstrating that EMF emitted by both living (flower parts) and inanimate (magnet) material attract iron laden crystals in the evaporated paramagnetic solution are summarized and demonstrate comparable qualitative biomagnetic images between the flowers and the pollinator parts.

In Figure 1. Control SSP dry field of Potassium Ferricyanide (Fe3) solution mixed with Prussian Blue stain. Note the pattern of flowery crystals displayed uniformly throughout the field,

Figure 2 provides evidence that paramagnetic crystals are attracted towards a magnet fragment EMFs,

Figure 3 This microphotograph of shows a similar crystallization of Fe3 around and contacting the end of the stamen of the pink rose after SSP evaporation.

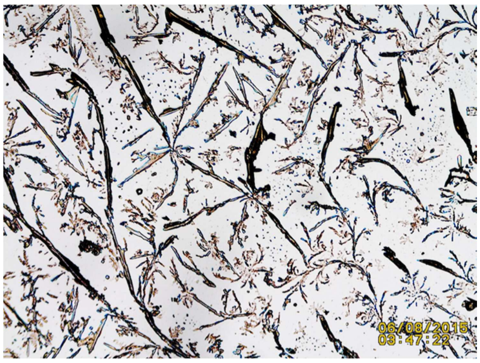

Fig. 1. Control SSP dry field of Potassium Ferricyanide (Fe3) solution mixed with Prussian Blue stain. Note the pattern of flowery crystals displayed uniformly (no accretion) throughout the field. This microphotograph contrasts with the pattern observed when living plant, animal and magnet material (Figures 2, 3, 4 & 5)) were part of the SSP containing the Fe3 solutions.

Fig. 2. Microphotograph of SSP Fe3 solution after evaporation. In contrast with Figure 1, the magnetic forces triggered aligned (by attraction) Ferricyanide crystals accretion seen around the EMFs emitted by the magnet fragment. Demonstration of the Fe3 solution paramagnetic property.

Fig. 3. Microphotograph of an SSP of the stamen (arrow) of the pink rose after evaporation of the Fe 3 solution, showing heavy Fe 3 crystallization accretion and aggregated iron particles around and contacting the end of the filament shaft.

Figure 4 illustrates an example of a portion of a jasmine petal showing heavy Fe3 crystallization and aggregated iron particles around and contacting the petal edges. Note that the same heavy crystals grouping of Fe3 formed after evaporation surrounding and contacting the magnetic fragment and lastly,

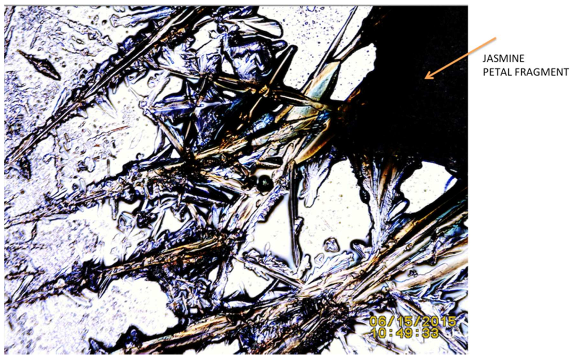

Fig. 4. SSP F3 Microphotograph of Jasmine (Jasminum) petal fragment showing the Potassium Ferricyanide crystals grouping at petal's edge. Demonstration of biomagnetism in an Angiosperm flower part.

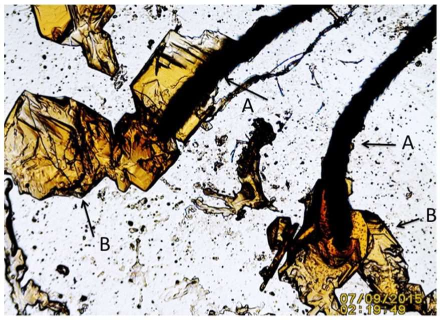

Fig. 5. SSP Fe3 microphotograph showing A= Ant pollinator long antennae tip and B= Large Potassium Ferricyanide crystals. The crystallization acretion is attributed to the biomagnetism present in the antenna. The insect pollinator was identified as a small ant.

Figure 5, shows that when the antennae of the nocturnal pollinator found in the *Jasminum* petal were viewed as an SSP Fe3, the same heavy Fe3 crystallization accretion was observed surrounding and contacting the end of each antenna and leg joints.

4. Discussion

4.1. Major Findings

In this report, we demonstrated the presence of EMFs in both the flower parts of 5 different Angiosperms. EMFs were also found in the antennae tips of nocturnal pollinators by the use of a technique we have originally applied to animal tissues [1, 2] and other plants [3]. Notably, on two occasions, the jasmine (*Jasminum*) flowers were found inhabited by nighttime pollinators. The insects were viewed under the microscope and found to resemble small ants. They were also studied by immersing them in a Fe3 SSP. A total of n=4 ant pollinators were visualized and all showed signs of biomagnetism in both of their antennae (short and long) as well as in their the legs (Fig 5)

4.2. Background

Pollination and Plant Signals:

Cross Pollination is the process of pollen transfer from the anther (male part of the flower) to the stigma (female part). This process requires an agent (such an insect) to enable fertilization and reproduction. In this report we are presenting the presence and methodology used to demonstrate electromagnetic forces (EMFs) found in flowers of 5 Species of Angiosperms, as well as insect pollinators.

The present paradigm on flowering plants reproduction is the "Pollination Syndrome Hypothesis" (PSH). It is described as "suites of phenotypic traits hypothesized to reflect convergent adaptations of flowers for pollination by specific types of animals" [5]. This syndrome was first introduced in the 1870's. At present, in divergent views some authors support this concept albeit with a caveat stating "Floral evolution has often been associated with differences in pollination syndromes. Recently, this conceptual structure has been criticized on the grounds that flowers attract a broader spectrum of visitors than one might expect based on their syndromes and that flowers often diverge without excluding one type of pollinator in favor of another" [6]. Despite the criticisms, some researchers support the concept by stressing its utility, while others cannot explain the variations [7].

In a recent report, living matter such as the human hair follicle most distal tip EMFs were linked to metabolic activity [8] The living flower being a living entity exhibits metabolic activity [9], thus expected by definition to have biomagnetic properties. We hypothesize that all living matter maintains an intrinsic, electromagnetic homeostatic mechanism at quantum levels based on biochemical and biophysical processes. Magnetic measurements indicate the presence of magnetite in the antennae of ants such as the *P. marginata* [10] and the antennae parts have been found to "suggest a possible magnetoreception function" [11]. in Bees (also a pollinator) iron granules have been reported. "The granules increase in both size and number during ageing…. and maximal iron levels are reached at the time when honey-bee workers commence foraging behavior, suggesting that iron granules may play a role in orientation" [12].

5. Conclusion

The Pollination Syndrome Hypothesis has been found to have unexplained gaps, we introduce biomagnetism as a new universal and unifying cross pollination hypothesis stating that "Biomagnetic forces present in living tissue, such as in reproductive flower parts and pollinators act as beacon signals used in plant reproduction". Biomagnetism is thus added to the list of signals between flowers and pollinators and could explain the gaps in knowledge found with the present Pollination Syndrome Hypothesis.

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