Proc. of the Second Intl. Conf. on Advances In Bio-Informatics, Bio-Technology and Environmental Engineering- ABBE 2014.
Copyright © Institute of Research Engineers and Doctors, USA .All rights reserved.
ISBN: 978-1-63248-004-0 doi: 10.15224/ 978-1-63248-004-0-03

Biological Signals Transmitted by Longitudinal Waves Influencing the Growth of Plants

Konstantin Meyl and **Heide Schnabl**

Abstract

In the experiments presented the effects of transmitting information derived from the growth hormone gibberellic acid (GA) to peas over a distance of some meters have been measured. Transmission of the biochemical characteristics of GA was achieved through a carrier wave of approximately 6.78 MHz running along a copper wire comparable to a strip line from the gibberellic acid as the source of information to the exposed peas, which reacted by a statistically significant enhanced root growth. The measured averages of the germinating pea root lengths were compared to control values, i.e. values corresponding to untreated peas. While continuous GA transmission resulted in an average increase of root length by approximately 50-60%, a singular burst of 15 minutes could increase roots' length by an additional 42%, raising the increase relative to the control group by as much as 125% in total. Both values could be established with very high statistical significance. In a third experimental setup, the peas were treated instead of a GA-signal, with an apoptotic signal produced in *two* different ways: with a pulse carrying the information of peas (a) either stored anaerobically (48-100 hours) or (b) peas macerized and therefore decomparmented. The almost total inhibition of root growth showed, again with high statistical significance, that an information transmission must have occurred remotely. The molecule hypothesized should be *cytochrome c,* released by the stress occurring during the apoptotical process. Some hypotheses in technical as well as in biological respect are being discussed.

Keywords

Peas, Cell Communication, Signaling, Scalar Wave, Magnetic Field.

Prof. Dr. Konstantin Meyl
Furtwangen University, Germany
Faculty of Computer and Electrical Engineering (CEE)
prof@meyl.eu

Prof. Dr. Heide Schnabl
Universität Bonn, Deutschland (IMBIO)
Institut für Molekulare Physiologie und Biotechnologie der Pflanzen

Correspondence Address:
Prof. Dr. Konstantin Meyl
First Transfer Center of Scalar Wave Technology (1.TZS),
Erikaweg 32, D-78048 Villingen-Schwenningen, Germany,
email: Prof@meyl.eu

I. Introduction

A. *About the effects of gibberellic acid (GA) on plant systems*

In higher plants, many physiological processes are being regulated by plant hormones, e.g. cell division, cell differentiation, the extension growth of plant organs and the induction of protein synthesis. Gibberellic acid (chemical structure Fig. 1) is a plant hormone stimulating cell division and cell extension growth of plant cells. Induction of seed germination is triggered by GA as well: The presence of gibberellic acid interrupts the state of dormancy adhered to by the seeds of most plants and lets the cells of the radicle elongate because of the induction of certain enzymes, such as amylases, proteases and other hydrolases by GA [1], [2]. Consumption of respective reservoirs such as carbohydrates and proteins is being initiated this way; the seedling is being supplied with nutrients and energy and is thus able to differentiate itself into root and shoot. During this process, both the synthesis rate of α-amylase and the concentration of m-RNA via added transcription of the amylase gene are known to be increased [3].

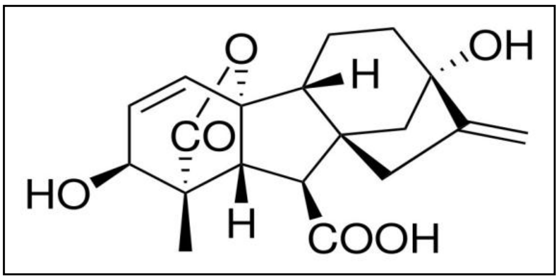


Fig. 1: *chemical structure of gibberellic acid (source: Wikipedia)*

This ability of gibberellic acid – stimulating the germination differentiation – is measured as accelerated root growth of seedlings.

In the case at hand, it was our intention to both prevent immediate contact of the seeds with the hormone and to ensure constancy of environmental factors such as light and temperature in order to eliminate internally induced influences on the germination process.

To this end, the carrier wave of a scalarwave transponder kit [4], (see Fig. 3 and 6), modulated with the GA information on one side of the kit was used to be transmitted to the peas on the other side of the transponder over a distance of approx. 3 meters. The effects of this transmission could then be measured as an indicator of a possible biological reaction.

The fundamental question is how to interpret any germination increase or growth stimulating effects if the peas did not get into contact with the hormone itself, and were incubated under constant environmental conditions. To examine this kind of information transmission over some distance, it was necessary to compare the experimental GA-data to controls as large as possible.

The distance between the information source (modulated with the hormone information) and the peas was bridged by way of the mentioned scalar wave transponder [4]. We used a standardized experimental kit differing from other common scalar wave systems in that one or multiple receivers can be linked to one emitter. As they maintain resonance through a connection cable, the complete absorption of the emitted power can be ensured. In this way, possible biological harm through possible stray magnetic fields can be avoided. The scalar waves serve as carrier for the biological information.

Proc. of the Second Intl. Conf. on Advances In Bio-Informatics, Bio-Technology and Environmental Engineering- ABBE 2014.
Copyright © Institute of Research Engineers and Doctors, USA .All rights reserved.
ISBN: 978-1-63248-004-0 doi: 10.15224/ 978-1-63248-004-0-03

B. A new approach to the communication of cells (according to [5])

The spatially arranged structural formula of gibberellic acid consists of multiple pentagonal and hexagonal ring systems (Fig. 1). From the benzene circle or the pyrimidine ring, as they occur in the base pairs of DNA, we know the delocalized electrons that freely move about inside the ring.

When you bring these rings (they are pretty common in organic chemistry) into a magnetic field, then electrons start to move due to induction. What we deal with is a frame antenna for the reception of high-frequency signals.

The induced loop current is capable of saving the magnetic field and then release this stored energy as information, much like a source or transmission antenna (Fig. 2).

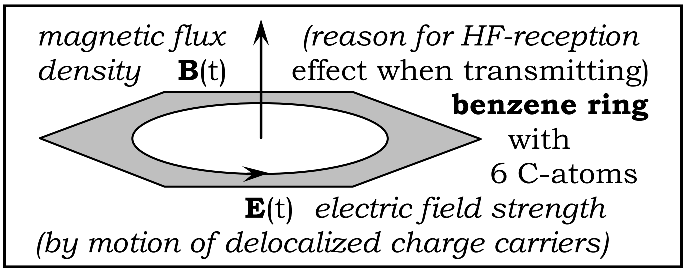


Fig. 2: *Ring systems using the benzene circle as an example, acting for Propulsion and as antennas of organic chemistry.*

This is the basis used by Meyl to explain cell communication, as well as the reading and writing of DNA-bound genetic information [6]. Should the substance-bound effect of the growth hormone upon excitation in a magnetic field be transferred to the motion of the ring electrons, then the result is the modulation of the created magnetic field.

The model concept assumes that the information can be transported after the electrons in the ring have received it from the chemical substance. There is however another problem that asks for a technical solution.

Magnetic fields don't have a big reach, especially not when they are caused by such weak currents. To make the transmission over a larger distance possible the modulated magnetic field has to be modulated onto an electrical field.

C. Experimental setup with the transponder kit

By default, inductivity and capacity are in use of the oscillating circuit for the shown setup (fig. 3). A peculiarity however is that the capacitor plates are pulled far away from each other, here the distance is 3 meters.

Between both electrodes of the capacitor, that are balls instead of the more common plate variant, the electrical field spans from one ball electrode to the other in a longitudinal way. This further improves the emission. The inductivity consists of 2 flat coils that are connected via a long cable with each other.

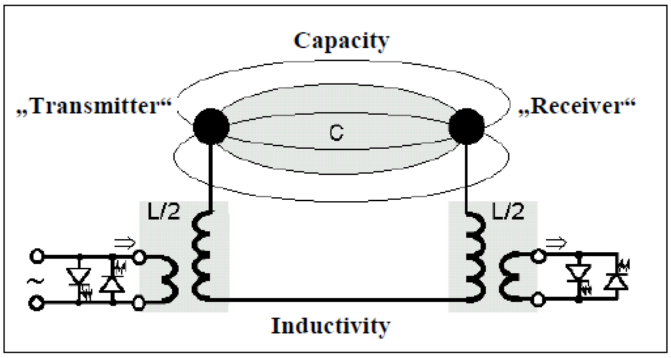


Fig. 3: The scheme for the resonant circuit transmission

The flat coil on the upper side of the circuit board (makes for) establishes an ironless transformator in combination with the coupling coil at the bottom. Both coils are identically built and equipped with LEDs to display any eventual current. A sinus function generator induces a coil that is to be called "transmitter" while the other one will be the "receiver".

If we think of the flat coil with a connected ball electrode as a lambda/4-antenna, then a standing wave will form in self-resonance according to classical antenna theory. The tip of the antenna is the ball electrode, where a maximum of the electrical and a minimum of the magnetic field strength occurs. At the bottom of the antenna the opposite happens with Minimum of the E-field and Maximum of the H-field (Fig. 4b)

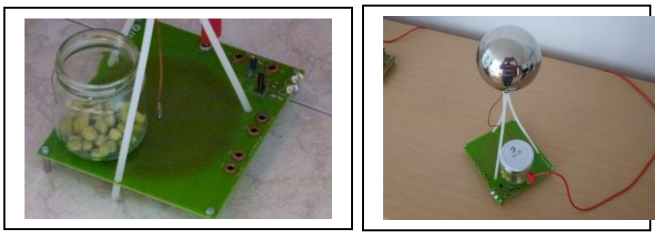
High-frequency stimulation through the coupling coil makes the antenna act like a charge pump at its bottom, where the magnetic field is at its strongest. This "charge pump" puts an electrical current on the connection line, which oscillates back and forth between transmitter and receiver. The characteristic frequency of the oscillatory circuit comes to about 6.78 MHz for the coils used here. It's a special case of resonance in which transmitter and receiver are in antiphase, yet oscillate with the same frequency.

D. How to optimize the experimental setup

The antiphase behaviour seen in the present test should, however, be avoided. Experiences with similar transmissions, for example the Canesten and yeast culture test [7] have shown a doubling of the performance when *two* receivers were used. To do this a second, identically built receiver is connected to the transmitter. Because of the antiphase behaviour both receivers, compared to each other, oscillate equiphase, which means there's a repulsion towards the carrier wave. This seems to support the detachment process of the information from the carrier wave.

The statement about the field distribution of the antenna has been checked by technical measurements as well. The maximum of the magnetic field strength is indeed located at about half the wire length between the ball electrode and the connection line. The point lies on the outer third of the flat coil as a measurement using a magnetic field probe that has told us.

Right here is where the coupling coil is placed on the bottom of the circuit board to optimize the induction process and this is also where, on the upper side, the biological substance should be brought into the magnetic stray field (Fig. 4). In practice the glass has a spatial extent of course, but this proves to not be a big issue as the maximum is not especially distinctive and the full coil surface may be used.



a) Receiver of Information *b) Transmitter of Information*

Fig. 4a, b: Where the test glasses are placed with the Test peas (a) resp. with the (GA) source of information (b) on the pancake coil.

To maximize the overlay of the magnetic fields of the substance and of the high-frequency carrier, which is interpreted as modulation, a watery solution inside of a glass container is preferred. Experiments have proven that the permittivity of glass and water is about the same. Plastic bottles however may dampen the weak magnetic signals of the samples to the point where transmission is no longer possible.

II. Experimental Design

The pea seeds (Pisum sativum, var. Kelvedon Wonder) were initially soaked in deionized water for 12 hours before they could be handled under differing conditions. After the wave treatment in incubation bowls (30x15cm), the seeds were distributed on damp fleece mats (30 seeds/bowl) and incubated under constant environmental conditions. After a given time (24, 30, 36, 48, 54, 60 and 72 hours) the lengths of their germinated roots were measured.

Proc. of the Second Intl. Conf. on Advances In Bio-Informatics, Bio-Technology and Environmental Engineering- ABBE 2014.
Copyright © Institute of Research Engineers and Doctors, USA .All rights reserved.
ISBN: 978-1-63248-004-0 doi: 10.15224/ 978-1-63248-004-0-03

A. *Experiment 1*

The pea seeds that received *permanent treatment* (15/per container) were placed in incubation vessels (5cm in diameter) and set on a receiver module in a specific position (see Fig. 4a). After the preset time intervals, their root lengths were determined

B. *Experiment 2*

The pea seeds that received a *pulse treatment* of 15 minutes while in identical incubation vessels were thereafter moved into incubation bowls (30 per bowl) with damp fleece. Their root lengths were measured after the preset intervals (Fig.5).

Fig. 5: *Incubation bowls in which the treated pea seeds are being germinated on damp fleece and under constant environmental conditions*

The second receiver, in a position illustrated in Fig. 6, was loaded with either gibberellic acid (10^{-5} molar) during the permanent and pulse treatment or – alternatively – specially processed peas to transmit the apoptosis signal. For this, two approaches were chosen:

Fig. 6 Positioning of power-transmitter (center), the first receiver (left) with the pea seeds to be treated and the second receiver (right) with the gibberellic acid as information source (or the apoptosis signal emitting peas, respectively).

C. *Experiment 3a*

10 peas that after 12h of initial soaking were brought to germination for 24h in incubation bowls until a predefined root length was reached (ca. 4.2 mm). After anaerobic storage in water (48-100 hours) (Fig.7), they were used as an information source.

Fig. 7 Information source of the apoptotic signal (Exp. 3a) (10 peas, 48-100h anaerobic storage in water)

D. *Experiment 3b*

To transmit another apoptotic signal, 10 peas, about 12 hours pre-soaked were *macerized* (mushy peas), mixed with water and placed in position on the second receiver.

III. Results

A. *Experiment 1*

Continuous treatment of the peas with gibberelic acid modulation

Fig.8 displays the root lengths of the pea seedlings after a *continuous treatment* with a carrier wave modulated with GA. After an incubation period of 72 hours, they averaged a length of 12.5 mm in contrast to the untreated control group average of 7.9mm, equalling a percentage increase of 57%. These results are based on 9 control groups, so that overall, 405 peas were measured. Conversely, 4 series with continuous treatment were performed, encompassing 100 pea roots. On the basis of a statisitcal two samples t-test, assuming normal distribution and homogenous variance, this yields a t-value of 6.88 at 508 degrees of freedom, a statistically highly significant result.

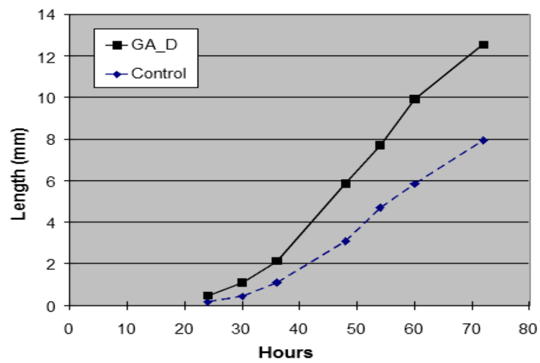


Fig. 8: *Growth of the pea roots after 72h of incubation under continuous treatment with GA information (100 peas from 4 test series) in comparison to the untreated control group (405 peas from an overall 9 control series). There is an average length increase from 7.9mm (control) to 12.5mm (GA) = 57%.*

B. *Experiment 2*

Pulsed treatment of the peas with gibberelic acid modulation

Fig. 9 shows the effect of a 15 minute pulse treatment in relation to both control and continuous treatment groups, consisting of an additional root length growth (*additional* 42% in comparison to the continuous treatment). Statistically, the result is highly significant with a t-value of 4.74 at 178 degrees of freedom.

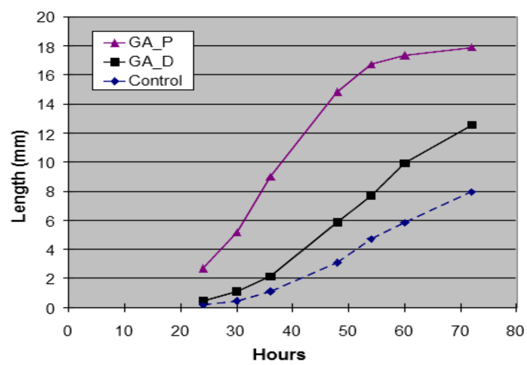


Fig. 9: *Growth of the pea roots after 72h of incubation after 15 minutes of treatment with GA information (top curve, GA_P)) in comparison to control group (bottom curve) and continuous treatment group (center curve, GA_D).*

Proc. of the Second Intl. Conf. on Advances In Bio-Informatics, Bio-Technology and Environmental Engineering- ABBE 2014.
Copyright © Institute of Research Engineers and Doctors, USA .All rights reserved.
ISBN: 978-1-63248-004-0 doi: 10.15224/ 978-1-63248-004-0-03

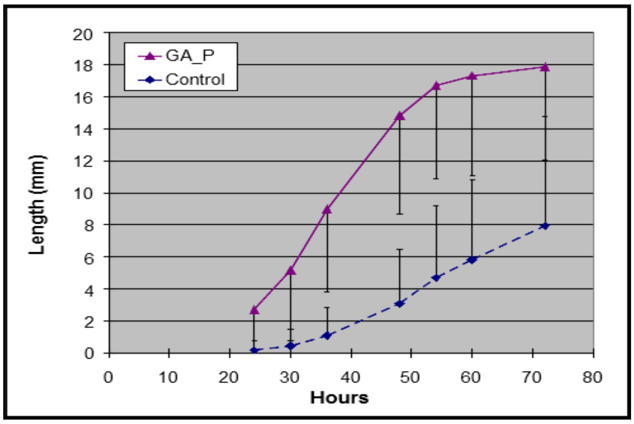


Fig. 10: *Growth of the pea roots after pulse treatment (15min) compared to an untreated control group results in an increase of statistically significant 125%.*

The differences between both GA curves (GA_D and GA_P) are highly significant compared to the control groups (Fig. 10), with the average root length of the pulsed treatment group (GA_P) being as much as 125% higher than the control group. The values of the GA pulse treatment derived from 3 different experiments with an overall 80 peas with an average root length of 17.9mm after 72h. With an extraordinary high t-value of 12.2 at 483 degrees of freedom they are once again highly significant.

Experiment 3 is about the Transmission of an apoptotic signal from the second receivers position.

C. *Experiment 3a*

from pea seeds after anaerobic storage (48-100 hours)

Fig. 11 shows a clear *inhibition* of root length growth due to the anerobically stored peas' signal from the second receiver, to only 1.3mm after 72 hours of incubating (top curve, GA_P). This result, which is based on 2 independent series with an overall 55 peas, is statistically highly significant with a t-value of 15.1 at 133 degrees of freedom. It is also of interest that anaerobic storage of less than 48 hours resulted in *no* inhibition of root length growth of the peas undergoing treatment.

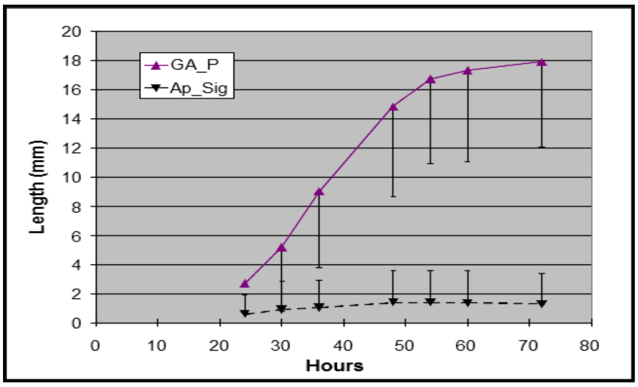


Fig. 11: *Growth of the pea roots after GA pulse treatment (15min) (top curve, GA_P) vs. pulse treatment (15min) from anaerobically stored peas (AP_Sig, bottom curve).*

D. *Experiment 3b*

from pea seeds after macerization

Fig. 12 shows the average root length growth inhibition to 3.6mm (from a series with 30 peas) that was achieved by a 15 minute pulse of macerized pre-soaked peas. [In this case, the results too are statistically highly significant with a t-value of 11.9 at 108 degrees of freedom.]

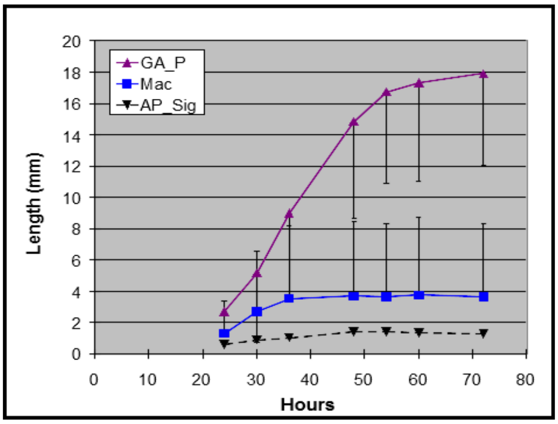


Fig. 12: *Inhibition of root length growth after pulse treatment (15min) from macerized pre-soaked (12 h) peas (center curve, Mac) in comparison to the anaerobically stored (bottom curve, AP_Sig) and GA pulsed series (top curve)*

IV. Discussion

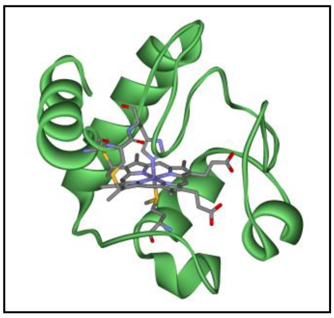
A. *Discussion from a biological viewpoint*

These results can be summarized in that they all displayed high statistical significance.

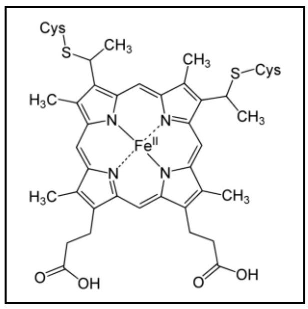
In the experiments 1 and 2 a biologically effective signal – in this case GA in 10^{-5}M solution – could be transmitted over a distance of about 3m without any structural chemical agency, as indicated by the increased root growth (see Figs. 8, 9 and 10).

According to the common understanding of biology, a growth stimulation of the seedlings can either be caused by an *external* addition of GA to the incubation medium or by an increased *internal* synthesis of GA, induced for example by higher temperature and/or light conditions. Since both were definitely excluded, the described positive biological effect of the increased root lengths should be due to the electromagnetic transmission of the biological GA signal exclusively. The mechanism outlined in the introduction could then lead to the induction of the respective enzymes which in turn would cause the measurable growth.

Figs. 11 and 12 show that a negative effect of high statistical significance manifests as a radical inhibition of root growth over a distance of several meters. This presumably apoptotic signal was generated by preparing peas in two ways: (a) by an anaerobic storage of already germinated peas over 2-5 days and alternatively (b) by macerized, i.e. structurally decompartmented peas that had been pre-soaked for 12 hours. In both cases, an *apoptotic signal counteracting* root growth was likely created due to a stress reaction.



a)



b)

Fig. 13a,b: *band model of cytochrome c with the prosthetic group heme-c as model a) and chemical structure of heme c with 4 pyrrole-rings in a porphyrine-ring (b) (source: Wikipedia)*

Copyright © Institute of Research Engineers and Doctors, USA .All rights reserved.
ISBN: 978-1-63248-004-0 doi: 10.15224/ 978-1-63248-004-0-03

It is known that stress reactions of various kinds cause initiation of apoptosis, indicated e.g by a release of cytochrome c from the mitochondria [8]. It can be assumed that anaerobically stored peas (48-100 hours) show a damage of the mitochondria induced by oxygene deficiency correlated to a release of cytochrome c and other proapoptotic factors from the mitochondrial intermembranous space through mechanisms yet unknown [8]. Via the coupling of the cytochrome c as a proapoptotic factor and dATP to Apaf-1 (apoptotic protease activation factor 1), a conformation change of the protease is effected. This signal is assumed to be a prerequisite for the autolytic activation of caspase 9 and thereby triggers the activation of the apoptotically induced signal chain [8, 9].

B. Discussion from a technical viewpoint

An interesting fact in this context is that both the gibberelic acid molecule as well as the cytochrome c incorporate *ring systems*, whose electrons are free to move via mesomery. These ring systems, ubiquitous in organic chemistry, are stimulated by magnetic fields and set into motion through induction, effectively creating a frame antenna for the reception of high frequency signals. Acting as an emitter, the ring atoms can transmit stored information [10].

In summary, the above points lead to the hypothesis that two different signals – in the case of growth stimulation a GA specific signal, in the case of growth inhibition a cytochrome c specific signal – can be transmitted over a certain distance. These signals apparently triggered the same biological reactions in the receiving peas as material biochemical molecules.

Both signal molecules – gibberelic acid and cytochrome c (Figs.1 and 13) – incorporate ring structures containing mesomerous electron clouds. Since these electrons are freely movable, they react to externally applied magnetic fields by a displacement. The induced currents in the ring generate a magnetic field acting as a loop antenna. As known from the high-frequency technology the electric current and the magnetic field can be modulated, so they become the carrier of information. This is done by placing the sample with a biological substance in the magnetic field of the coil. Thus, the information of the signal-releasing molecule (GA or cytochrome c) is transported to a biological receiver and reflected accordingly there.

The scalar wave concept could as well answer the unexplained findings of Luc Montagnier et al.[11].

The finding could lead to fundamental consequences for today's understanding of biological communication:

- Rings with delocalized electrons act as magnetic field antennas.
- Organic ring antennas receive, store or transmit signals.
- The rotating electron ring creates a magnetic field.
- The magnetic field holds energy and modulated information.
- Nature communicates in a wireless manner by using the H-field
- Perpendicular to the magnetic field pointer the electrical one is.
- The electrical field vector oscillates in step with the information.
- The modulation is executed by a high-frequency carrier wave,
- and transmits the oscillations over long distances.

In conclusion and on the basis of three highly significant test results, it seems that the chemical paradigma is not necessarily complete. Instead, the effect of some *corporeal* molecule structures can seemingly be transmitted over greater distances by means of electric and magnetic fields.

References

[1] T.J.V. Higgins, J.V. Jacobsen and J.A. Zwar, "Gibberellic acid and abscisic acid modulate protein synthesis and mRNA levels in barley aleurone layers", *Plant Molecular Biology* 1 (3): pp.191-215, 1982.

[2] J.E. Varner and D.T.-H. Ho, "The role of hormones in the integration of seedling growth". In: J. Papaconstantinou, Ed., *The Molecular Biology of Hormone Action, Acad. Press*: p.173, 1976.

[3] J.V. Jacobsen and L.R. Beach, "Control of transcription of α-amylase and t-RNA genes in barley aleurone protoplasts by gibberellic and abscisic acid". *Nature* 316: pp.275-277, 1985.

[4] K. Meyl, Scalar Wave Transponder, Field-physical basis for electrically coupled bi-directional far range transponders, INDEL publisher, ISBN: 978-3-940 703-28-6, 2006.

[5] K. Meyl, DNA and Cell Resonance, Communication of cells explained by field physics including magnetic scalar waves, INDEL publisher, ISBN 978-3-940 703-17-0, 2011.

[6] K. Meyl, "Task of the introns, cell communication explained by field physics", *JOURNAL OF CELL COMMUNICATION AND SIGNALING*, Volume 6, Number 1: pp. 53-58, DOI: 10.1007/s12079-011-0152-0, 2012.

[7] J. Ebbers and K. Meyl, "Drug Effects in Yeast mediated by Scalar Waves", Medical Science, 2014, 8(30), pp. 58-62, discovery publication, May 21, 2014.

[8] M.O. Hengartner, "The biochemistry of apoptosis", *Nature* 407, 6805, pp. 770-776, 2000.

[9] J. Yuan and B.A. Yankner, "Apoptosis in the nervous system". *Nature* 407, 6805: 802-809, 2000.

[10] K. Meyl, "DNA and Cell Resonance, Magnetic Waves Enable Cell Communication", *DNA and CELL BIOLOGY*, 31(4), pp. 422-426. doi:10.1089/dna.2011.1415 (www.meyl.eu, > papers), 2012.

[11] L. Montagnier, J. Aissa, E. Del Giudice, C. Lavallee, A. Tedeschi, G. Vitiello, "DNA Waves and Water", *Journal of Physics: Conference Series*, 012007: 306, doi:10.1088/1742-6596/306/1/012007, 2011.

About the Authors:

Corresponding Author is Dr. Konstantin Meyl from Germany. He is Professor of power electronics at Furtwangen University, belonging to the faculty of Computer and Electrical Engineering. He has founded the first Transfer Center of Scalar Wave Technology 27 years ago, where his research takes place. For corresponence please use the address of his institute or ask him personally (www.meyl.eu). He is responsible for the electronic part and the field physics behind this paper.

Second author is Dr. Heide Schnabl from Germany. She is Professor em. from University of Bonn and belonged to the Institute of Molecular Physiology and Biotechnology of the Plants. She is responsible for the treatment of the peas, used for indicating the communication of plants.

Correspondence Address:

Prof. Dr. Konstantin Meyl
First Transfer Center of Scalar Wave Technology (1.TZS),
Erikaweg 32, D-78048 Villingen-Schwenningen, Germany,
email: Prof@meyl.eu