Experimental

THE EFFECT OF ZERO MAGNETIC FIELDS ON INITIAL GROWTH OF RICE

Shigemi Sasaki, Ph.D & Tiejun Miao, Ph.D

ABSTRACT

There has been an explosive resurgence of interest by the scientific community in the effects of very weak extremely low frequency (ELF) electromagnetic fields on biological systems. This paper investigates the special case in which zero magnetic fields (ZMF) are able to cause changes in biological systems through the zero frequency resonance interaction. The study may give an insight to the underlying mechanism of the ELF interactions. On the other hand, the ZMF generated by the cancellation of magnetic fluxes around the non-inductive coil obeys Taiji (Tai Chi) principle, and hence, should create a vital energy Qi according to notions of traditional Chinese medicine. We suggest the existence of Qi playing key role in the ZMF interactions. This study is to accumulate data to explore the ZMF properties in relation to the vital energy Qi.

Zero magnetic fields (ZMF) are developed by the use of a non-inductive coil consisting of a crystal. Starting from seed germinations, the lowland paddy rice being exposed to the ZMF has been examined for its initial growth. There are three findings. (1) With a statistical significance of reliability up to 98-99%, an observable change in the rice growth due to the ZMF influence has been demonstrated by measuring the bud and root lengths of the rice; (2) The ZMF acts on the growing rice as a growth promotion or growth acceleration when the condition, such as having enough sunlight, is natural and helpful to the plant development; (3) Conversely, it acts as a growth check or growth delay under bad conditions like no sunlight shining on the rice.

KEYWORDS: Zero magnetic fields, ELF, vital energy, Qi, non-inductive coil, growth, rice

INTRODUCTION

There has been an explosive resurgence of interest by the scientific community in the effects of very weak extremely low frequency (ELF) electromagnetic fields on biological systems.[1,2] A variety of biological effects have been attributed to exposure of living cells or organisms to the magnetic fields. Some of these fields have been used successfully in the healing of recalcitrant bone non-unions.

The lack of consensus on a definitive mechanism that can explain the action of the very weak ELF magnetic field on biological systems have divided the scientific community. Several factors contribute to the controversy. First, the amount of energy emitted by the fields is considered to be too low to act through known physical mechanisms of heating, dielectric breakdown, partial displacement or electrophoresis. Second, it is unlikely that the mechanism of action is derived simply from cells or organism, owing to this very weak magnetic field in comparison to the endogenous field in cells or organisms. Third, the diversity in experimental effects observed is large, suggesting complicated and multiple routes of activity.

Several unifying models have been proposed to explain the mechanism of interaction of very weak ELF electromagnetic radiation field with biological systems. The ion cyclotron resonance (ICR) theory has been particularly effective in explaining why the ELF interaction requires the correlation of weak magnetic field intensity B with ELF frequency f of the magnetic field.[1] According to the concept of ICR,[3] the cyclotron resonance condition follows the formulation,

$$f = \frac{q}{2\pi m} B$$

with the charge-to-mass ratio of q/m. This implies that the ratio f/B remains a constant for a given ionic charge-to-mass ratio q/m.[3] For example, when value B is decreased, the resonance frequency f should decrease correspondingly in keeping the resonance interaction. In particular, if B is reduced to as close to zero as possible, then f should correspondingly approach zero too. This reasoning suggests that zero magnetic field (ZMF) is able to cause changes in biological systems through the zero frequency resonance interaction. Study of

this special case could give insight to the underlying mechanism of ELF interactions.

Another reason why we are interested in $B = 0$ interactions is that the ZMF generated by the cancellation of magnetic fluxes around the non-inductive coil obeys Taiji (Tai Chi) principle, and hence, should create a vital energy Qi according to notions of traditional Chinese medicine.[4] Actually, with the realization of the difficulty, at present, in explaining how the ELF interactions occur using conceivable physical processes, our working hypothesis is that there is a subtle energy, i.e., Qi, playing a key role in the ZMF interactions.[5-7] This study is to accumulate data to explore the ZMF properties in relation to the vital energy Qi.

Our researches have focused on establishing ZMF using non-inductive coil (NIC) systems, and developing experiments that can be used to assay the effects of the ZMF on biological system.[8] NIC is a coil made from twine wire in which currents flow from one line and back along another. The magnetic field created by the NIC system was found to be zero when an electric current passed through the wire. Recently, it was noted that for some unknown paranormal characteristics of a natural crystal usually used for treatment of illness in folk remedies, we combined a crystal into the NIC system in order to achieve an enhanced effect in the experiments.[9,10] We then studied the influence of ZMF on the initial growth of the rice.

EXPERIMENTAL

Characteristics of Zero Magnetic Field System

We have reported the effects of NIC on some targets including both biological and non-biological systems.[8,11] In this experiment, we used a natural crystal in addition to the NIC system.[5] The experimental apparatus is constructed as follows.

1. **A non-inductive coil (NIC) of twine wire is used.** The bent lines were first formed by bending at the midst of a copper wire covered by enamel-insulated material. The copper used was of 12m in length and with

diameter of 1.6mm. Then the bent lines were wound around each other in forming the twine wire with a shape of left rotated double spiral, *i.e.*, it follows right hand rule. Finally, the NIC was constructed of the twine wire bundles. Since electric currents will pass to one line of the twine wire and flow back through another when the power is on, the NIC generates zero magnetic fields (ZMF) due to a cancellation of the magnetic fluxes. The ZMF was monitored by the use of a Gauss-meter (Model 3254, Yokogawa Electric Corp.).

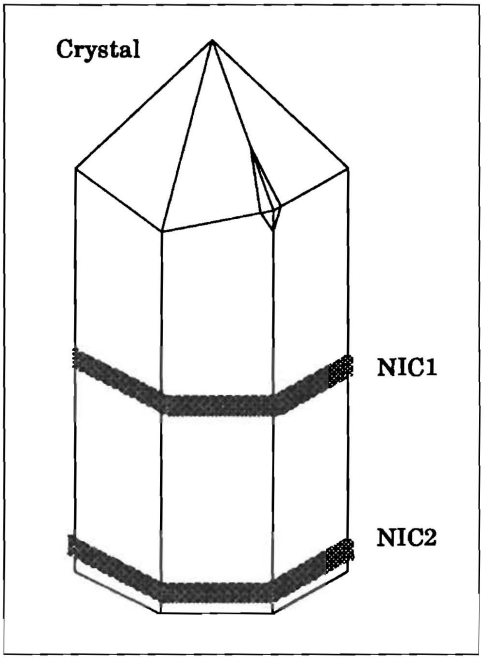

Figure 1. *The scheme of the experimental apparatus.*

2. **A crystal.** A transparent mono-crystal occurring in nature was used as an assisting part. The crystal was a Brazilian grade B rough quartz crystal, pillar-shaped in 6-edge in body and pyramid-shaped slopes surrounded its head portion. The height from the bottom to the top vertex is 33.2 cm. At the locations of the coils, the maxim and minim width of the crystal body is 17.0 cm. and 16.5 cm., respectively. Pyramid-shaped slopes surrounded its head portion. Only the bottom portion was ground flat and processed artificially.

The scheme of final assembled experimental apparatus is shown in Figure 1. Two non-inductive coils, i.e., NIC1 and NIC2, were made from tightly winding together wire bundles around the outside circumferences of bottom and center portion of the crystal. In Figure 1, two coils were in series connection and arranged parallel each other in coil planes. They installed to the crystal in parallel to the bottom plane of the crystal. One coil was distanced 16.5 cm. above the crystal bottom. Below this coil, another one was apart to it in distance of 15.0 cm.

Energizing the Apparatus

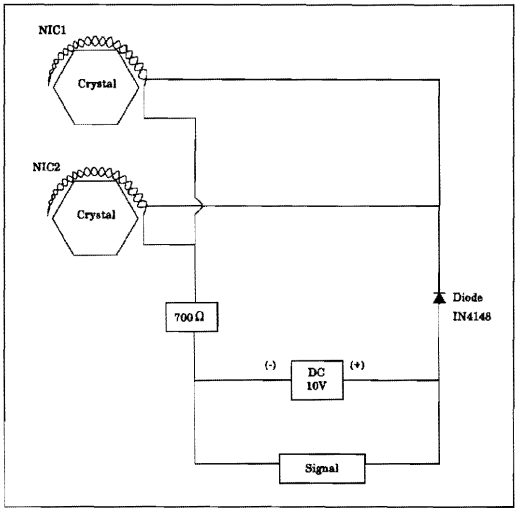

Figure 2. *Electric circuit of the driving system of the experimental apparatus.*

A combination of a signal source and a direct current was used to drive the NIC systems. Figure 2 displays the principal electric circuit. The pulse train generated from a signal source of Hashimoto Alpha Coil (Model II, Alpha Coil Company) varied from 30-290 in voltage and 6-16 in frequency (Hz). We selected 130V and 8Hz to produce the periodic pulsed signal. In Figure 2, 10 volts direct current (DC) was supplied from a battery. It gave an offset to the signal waveform. An example of the waveform (output) is indicated in Figure 3. The scope signal shown was taken at output of signal generator. The pulse waveform was in the form of half-sine wave with frequency of 8.0Hz. The current passed through an electric resistance of 700Ω and a diode IN4148, and then generated ZMF at the two NICs.

Characteristics of Rice Seeds

The seeds of paddy rice, called "Koshihikari", used in the tests were produced from Nagano Prefecture of Japan, and harvested in 1997. There was no disinfection treatment on the seeds and rice. The rice grown from the seeds were employed as the target. The experiments took about 2.5 months from 5 April to 18 June 1998.

The Experiment and Exposure Condition

Measurements of the initial growth of the rice were performed in a sunny place, in a laboratory of the Institute of Life Phenomena at Western Japan. Three sheets of filter paper were piled up and put in a glass petri dish 12cm in

Figure 3. *Output waveform of the signal source.*

diameter and 3cm deep. After putting the rice seeds on top of the filter papers, water was carefully poured and submerged contents to the middle height of the seed grain. Normal natural water was used at first and then changed to one mixed with 500 times diluted home gardening solution manure (Taisho Pharmaceutical, Inc.) after the seeds germinated. The rice grown up from the germinated seeds was observed by recording lengths of the plant bud and root. With assistance of ropes, the coils and the crystal system were hung from the vertex of a large wooden tripod, such that the bottom of the crystal was parallel to the ground field where the seeds container was placed horizontally. The rice seed samples were set right under the crystal bottom, making the center of the seeds container be coincident with the center of the crystal bottom area. The vertical distance between bottoms of the crystal and the seeds container was 48.0 cm. The equipment of signal generator and monitoring system were set in a place with 5 m. horizontally separating these from the coils and crystal system.

In the experiments, the power was turned on, then electric currents were passed to one line of the twine wire and flow back through another through the non-

inductive coils (NICs), each coil had two electric current flows around a common center, circulating in mutually opposite directions and complementary to each other. There would be a zero magnetic field (ZMF) region in the central portion of the coils due to a cancellation of the magnetic fluxes produced by the currents. The DC Gaussmeter (Model 3254, Yokogawa Electric Corp.) with precision of 1 milligauss and a range of ±2000 milligauss was employed to measure the magnetic field intensity at the location of rice seed samples in the experiments. The same value of 0.480 ±0.003 Gauss was found before and after adding the NIC system. It was consequently confirmed that the NIC system generated zero magnetic field (ZMF) at the samples' place, where the earth magnetic intensity at the latitude of our laboratory should be 0.480 Gauss.

In the control experiments, all experimental conditions were maintained the same except for the presence of the zero magnetic field (ZMF) from the coils system. In the control experiments, ZM, was not being applied to the seed samples during the tests.

RESULTS

In order to identify how ZMF correlates with quantitative changes in the growth of the rice, Figures 4-6 display normal probability plots of the measured data on a probability paper. The y-axis values are the cumulative probabilities and, as such, go from zero to one. X-axis corresponds to the values of bud (seedling) and root length. The scale for the y-axis is not uniform. The distance between the spacing on the y-axis matches the distance between the quantiles of a normal distribution. The quantiles are close together near the median (probability = 0.5) and stretch out symmetrically moving away from the median. In the plots, μ and σ denote a mean and a standard deviation, respectively.

Figure 4 is the result in an experiment carried out under the usual typical climate condition. Starting from seed germinations, the initial growth of the rice was examined for 11 days including 6 clear days, 4 rainy days, and 1 cloudy day. In these days, the rice was exposed to the ZMF for a total of 72 hours. There were 325 seeds used for the exposed samples and 235 seeds for controls. The probability plot for length of the rice bud is shown in Figure

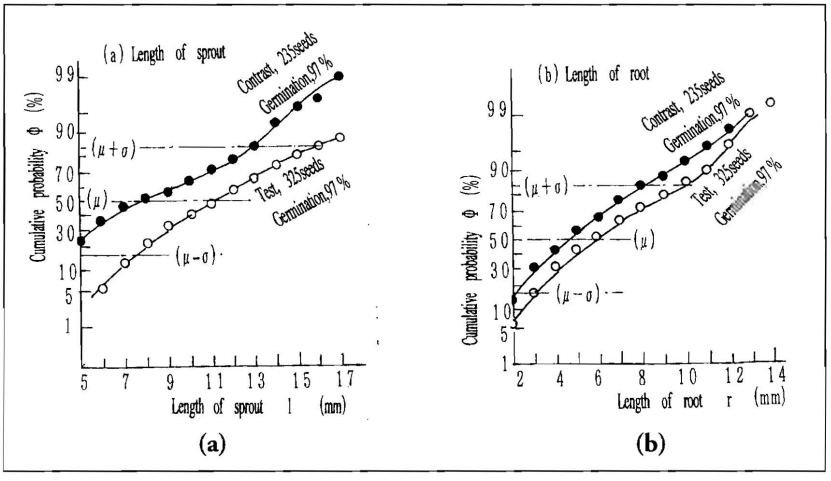

Figure 4a and 4b. *The result of an experiment carried out for 11 days. Samples were exposed to ZMF for a total of 72 hours. White circles and black circles denote the data recorded from experimental samples and controls, respectively. Probability plots are shown in Figure 4a (left) for length of the rice bud and in Figure 4b (right) for the length of rice root.*

4a, where white circles and black circles denote the data recorded from experimental samples and controls, respectively. Comparing the median of the bud length showed that relative to unexposed controls there were 47.0% increases in the experimental samples.

Similarly, as shown in Figure 4b, the probability plot for length of the rice root showed 27.0% increases in the test samples. In simply summarizing these two changes, there was totally 74.0% increase in the initial growth of exposed samples relative to controls. These appeared to be largely due to influence of ZMF on growth promotion of rice. In addition, the average length was 11.2cm for bud and 5.7cm for root, showing the root length being approximately one half of the bud. In the experiment, the germination rate was the same 97% for exposed samples and unexposed controls.

Another experiment was performed for 6 days including 2 clear days, 2 rainy days, and 3 cloudy days, starting from seed germinations. In this period, the rice was exposed to ZMF for a total of 67 hours. There were 440 and 340

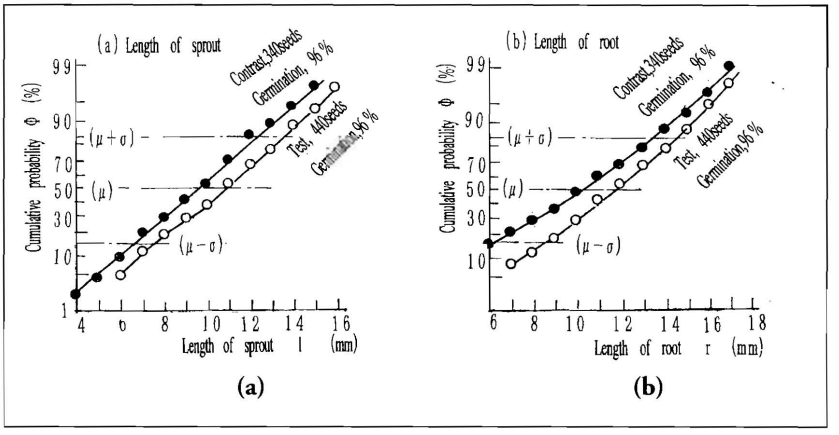

Figure 5. *The result of an experiment carried out for 6 days with exposure time of 67 hours. White circles and black circles denote the data recorded from experimental samples and controls, respectively. Probability plots are shown in Figure 5a for length of the rice bud and in Figure 5b for the length of rice root.*

seeds used for the test and control, respectively. Analogous to Figure 4, the probability plot showed that experimental samples increased 14.6% in bud length (Figure 5a) and 13.6% in root length (Figure 5b) in comparison with unexposed controls. The addition of these two changes gave a total of 28.2% increase, indicating the appearance of growth promotion in the exposed samples. Also the average bud length was about 11.7cm, which was approximately equal to the one of root length of 11.2cm. The germination rate was the same 96% for both exposed and unexposed seeds.

The third experiment was conducted under the similar condition as in Figure 5, except that samples were set in the bathroom where sunlight was not let in. Obviously, since the condition of the bathroom was not natural to the growing plant, there would be a growth check to the plant development. There were 513 seeds used for the experiment performed for two successive days (48 hours). The probability plot in Figure 6 showed that experimental samples decreased 6.9% in bud length (Figure 6a) and increased 3.4% in root length (Figure 6b) in relation to controls. Overall, there was a 3.5% decrease, or growth delay, in the exposed samples, indicating a growth check when bad conditions or environment were added to the growing rice.

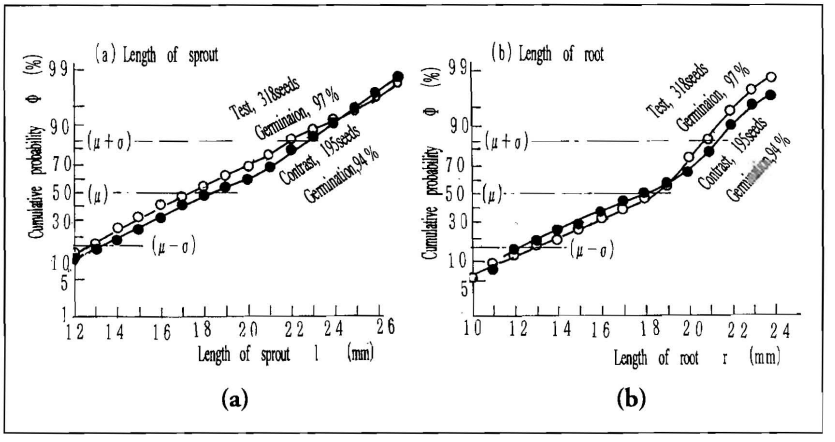

Figure 6. *The result of an experiment conducted under the similar condition as in Figure 5, except that the samples were set in the bathroom where sunlight was not let in. Probability plots are shown in Figure 6a for length of the rice bud and in Figure 6b for the length of rice root.*

CONCLUSIONS AND DISCUSSION

The probability plot of Figures 4-6 show that the data points fall nearly along a straight line, indicating that we can model the measured data through a normal distribution. In addition, *t*-test method is employed to check the statistical significance of the experiments. It shows that the experimental result in Figure 4 has a meaningful difference in relation to controls with $p < .01$. Similarly, for Figure 5, the *t*-test shows a meaningful difference of $p < .02$. In other words, the experiments shown in Figures 4 and 5 have the reliability up to either 99% or 98% showing a meaningful statistical significance.

In conclusion, a comparison of exposed samples with controls reveals an observable and conditional dependent change in the initial growth of the rice. The growth is indicated and measured by medians of the rice bud and root lengths. In details, as displayed in Figures 4-5, ZMF acts on the growing rice as a growth promotion or growth acceleration when the condition or environment is helpful and natural to the plant development. In the two typical experiments, the exposed samples total increase was 74.0% and 28.2% in the initial

growth compared to unexposed controls. Conversely, ZMF acts on as a growth check or growth delay in bad conditions. A bathroom experiment with no sunlight exhibited 3.5% decreases or growth delays of the exposed samples in relation to controls.

The major question of how ZMF initiates events during the rice growing process, remains unanswered. Our research has studied the question of whether the initial growth of the rice is affected, and we are now beginning to approach the assumption that a subtle energy (Qi) causes the interaction of ZMF with the biological systems.[4,5] It should be noted that the NIC described here produces a balanced cancellation between positive and negative magnetic fields, and creates ZMF when currents pass through the wires of the coil. The crystal in the experimental system is an assisting component and may enhance the effect of ZMF according to some hypotheses.[9,10]

Finally, we wish to address the ZMF-Qi connections. The so-called Taiji (Tai Chi) structure is formed in such a way that there are two flows around a common center, circulating in mutually opposite directions and complementary to each other. If the two flows are charged with some properties such as magnetic, electric, or mass, there appears a zero field region at the center due to cancellation of these fields achieved by two opposing flows. The Taiji (Tai Chi) principle postulated, on the basis of series of experiments,[5-7] that the zero regions of the Taiji structure have the function of capturing the vital energy Qi from around space. In details, the Qi having vital energy equal to $1/2[(-M)(ic)^2]$ with assumed minus mass $(-M)$ and imaginary light speed (ic) flows to the zero region as a sink. Actually, experimental apparatus having the Taiji structure were built and a series of experiments have been carried out in Japan and China,[5-7] in order to study the possibility of artificially controlling and gathering the vital energy Qi.

In this paper, when power is turned on, since electric currents will pass through one line of the twine wire and flow back through another in the non-inductive coils (NIC), each coil has two electric current flows around a common center, circulating in mutually opposite directions and complementary to each other. There will be a zero magnetic field (ZMF) region in the center portion of the coils due to a cancellation of the magnetic fluxes produced by the currents. Consequently according to the Taiji principle, the region of ZMF can gather the vital energy Qi from space.

Since Qi interacts with living systems in a way of long-range coherence,[4a] analogous to non-local interaction of quantum mechanics, it is reasonable to assume that the Qi is the underlying vital energy affecting the rice growth in the experiments. Furthermore, because the effect of the zero magnetic field interaction on biological systems is a special case of action of very weak extremely low frequency (ELF) magnetic field, effects of the very weak ELF electromagnetic fields may be, at least partly, associated with the vital energy Qi having long distance interaction properties, considering that so far there is lack of consensus on the interaction mechanism of very weak ELF electromagnetic fields through known short-range interacting physical mechanisms.

Many points are still left as future problems. We need to evaluate a total system electric field around all components in the experiment in detail. Also along with the environment factors, the distribution and changes of the geomagnetic field at the latitude of our laboratory is to be measured. There are some potential influencing factors to be explored in further studies. They are the various waveforms of the signal, types of crystals, circuit components, and so on. We plan to study the effects of the crystal, coils system, respectively, and to compare the effects with the results in this paper.

In the last few years, we have done a series of researches on ZMF in Japan and China using a variety of biological systems.[5,8] The targets used involve seven kinds of plants, eggs, hens, fishes, as well as the peripheral blood circulation system of the human skin. In general, it found that when the conditions encouraged growth development, ZMF functioned as a growth promotion. Conversely, in unfavorable conditions obstructing the growing life, ZMF worked as a growth delay action. We conclude that if growth promotion was expected under the effect of ZMF, various conditions and environments should be helpful and supportive of such development. Perhaps this could be used in achieving enhanced healing in individuals through the use of ZMF.

• • •

CORRESPONDENCE: Shigemi Sasaki, Ph.D. & Tiejun Miao, Ph.D. • Institute of Life Phenomena at Western Japan • 1769-2 Kawaguchi machi, Hachioji-city, Tokyo 193-0801, Japan.

ACKNOWLEDGEMENTS: We thank the chairman of board of directors of Exercising and Sporting Center for assistance of experimental setting, director of Nishimura Bureau for equipment standardization. A portion of the research was performed under the auspices of the Nagano Prefecture Foundation. We thank Dr. Seki and Mr. Kobayashi for review of the manuscript and recommendations.

REFERENCES & NOTES

1. A. R. Liboff, B. R. Mcleod & S. D. Smith, Ion Cyclotron Resonance Effects of ELF Fields in Biological Systems, *Extremely Low Frequency Electromagnetic Fields: The Question of Cancer* (Wilson Stevens, Anderson, Battelle Press, Columbus, OH, 1990).
2. J. I. Jacobson & W. S. Yamanashi, An Initial Physical Mechanism in the Treatment of Neurologic Disorders with Externally Applied Pico Tesla Magnetic Fields, *Neurological Research* **17** (1995), pp. 144-148.
3. A. R. Liboff, Cyclotron Resonance in Membrane Transport, *Interactions Between Electromagnetic Fields and Cells* (Chiabrera, Nicolini, Schwan, Eds., Plenum Press, New York, NY, 1985).

4a. T. Miao & S. Sasaki, A Quantum Mechanical Description of Qi and ESP Phenomena, *Psi Science* **17** (1995), pp. 10-16.

4b. S. Sasaki & T. Miao, Controlling Energetic Qi based on Yuanji Diagram, *Journal of Mind-Body Science* **4** (1995), pp. 61-69.

4c. S. Sasaki & T. Miao, The Relationship Between Taiji Diagram Theory and Qi to Provide a Comparison with Studies Conducted at Lianhua Mountain and Irino Valley, *Journal of Mind-Body Science* **5** (1996), pp. 47-55.

5. S. Sasaki, C. Zhang, F. Hu & N. Iwata, Effects of Artificial Qi Regulated with Zero-Magnetic Field and a Crystal on Plants, *Journal of Mind-Body Science* **22** (2000), pp. 21-29.
6. S. Sasaki, H. Liu, Y. Liu, F. Hu, H. Hayakawa & T. Ohki, On the Research of Electric Conductivity of "Qigong" Water and the Influence by Oxidation Reduction Potential (ORP), *Journal of Mind-Body Science* **6** (1997), pp. 9-16.
7. S. Sasaki, Y. Sako & T. Kobayashi, Characteristics of Qi Observed in the Changes of Qi-Water Conductivity, *Journal of Mind-Body Science* **2** (1993), pp. 1-7.
8. S. Sasaki, C. Zhang, H. Liu, F. Hu & N. Iwata, Influences of Zero Magnetic Field Induced by Non-Inductive Coils on Hatching of Fertilized Eggs and Growth of Chicken, *Journal of Mind-Body Science* **7** (1998), pp. 91-102.
9. S. Sasaki & T. Yamada, Experimental Study of Crystal Seven as the Source of Energies (Influence on Energies by the Spiral Directions of Coils and Plate), *Psi Science* **13** (1990), pp. 1-9.
10. W. J. Hooper, *All-Electric Motional Electric Field Generator, US Patent No. 3610971* (October 5, 1971).
11. S. Sasaki, H. Liu, Y. Liu & F. Hu, The Research of Zero Magnetic Field of Non-Inductive Coil and Its Influence on Distilled Water, *Journal of Mind-Body Science* **7** (1998), pp. 81-89.

∞ ∞ ∞