

The Effect of Mobile Phone Electromagnetic Waves on Honey Bee

This paper was downloaded from TechRxiv (<https://www.techrxiv.org>).

LICENSE

CC BY 4.0

SUBMISSION DATE / POSTED DATE

05-05-2023 / 11-05-2023

CITATION

Bozorgmanesh, Mohammad Amin; Kowkabi, Fatemeh (2023): The Effect of Mobile Phone Electromagnetic Waves on Honey Bee. TechRxiv. Preprint. <https://doi.org/10.36227/techrxiv.22770290.v1>

DOI

[10.36227/techrxiv.22770290.v1](https://doi.org/10.36227/techrxiv.22770290.v1)

The Effect of Mobile Phone Electromagnetic Waves on Honey Bee

Mohammad Amin Bozorgmanesh^{*}, Fatemeh Kowkabi

Department of Electrical Engineering, Marvdasht Branch, Islamic Azad University,
Marvdasht, Iran

*** Corresponding E-mail address:** mohammadamin.bozorgmanesh@gmail.com

ABSTRACT

With the advancement of technology, the development of telecommunication industries, the construction of new electrical devices, and the increasing use of electromagnetic field generators in modern industrial societies, the study of the biological effects of these waves on the growth and development of living organisms are of interest to many societies. The scientific world is placed. Today, one of the ecological problems is electromagnetic pollution in the environment. The use of mobile phones has increased in the world in recent years, which in turn adds to this pollution. Some bee species worldwide are becoming extinct, called the CCD phenomenon. Our goal in this article is to investigate the effect of electromagnetic waves and their relationship with the new phenomenon of CCD and to offer a proposal to guide bees to return to the hive by fluorescent blue light.

Keywords: Electromagnetic waves, Electric field, CCD phenomenon, Bee.

1. INTRODUCTION

Electromagnetism is a branch of physics that studies electrical and magnetic phenomena and their relationship [1, 2]. Electromagnetic phenomena in classical physics are studied under Maxwell's laws. According to Maxwell's theory, every moving charged particle emits energy. For the first time, Maxwell [3], obtained the magnetic wave equations and showed that electric and magnetic fields could have a wave-like behavior; According to his theory, electric fields that change with time causes the creation of magnetic fields. The increasing use of radio, television, radar, and telecommunications masts and high pressure has increased the amount of electromagnetic radiation in the environment [4].

A large amount of magnetic radiation in the environment is produced by mobile phone towers. Insects and small animals are the first living organisms affected by these radiations. If the number of masts and cell phones increases, honey bees may disappear within the next few years. Investigations have shown that the radiation of 900 MHz (MHZ) waves is very bioactive and causes changes in the physiological function of living organisms [5].

The honey bee is a branch of arthropods and in the category of insects, which are key species in the ecosystem that pollinates more than 90 commercial products around the world from honey bees [6]. Quoted from Albert Einstein: "If the bee disappears from the face of the earth, mankind will not survive more than four years!"

The increase in losses in bee colonies worldwide has caused a phenomenon in which the number of bees in the hive decreases quickly without any signs of disease [7].

Many studies have reported that radio frequency and electromagnetic radiation (EMR) create misleading biological effects that disrupt the functioning of the biological systems of living organisms [8]. This article suggests using fluorescent blue light in the bee colony to guide the bees back to the hive.

2. Magnetic orientation system in the honey bee:

Sometimes honey bees move more than 12 km away from the hive to collect food [9, 10]. Using their sense of sight and smell, they mark the surroundings of the hive and use them to find their way back to the hive [11]. In addition to marking by the sense of sight and smell, they can detect the earth's electromagnetic fields and use them for orientation [12, 13]. While flying, honeybees can detect weak magnetic field fluctuations of as much as 26 nT [14]. There are two types of magnetic orientation systems in animals:

2.1) Magneto-chemical orientation system [15]: The magneto-chemical orientation system is also known as light-dependent magnetic sense and is carried out by cryptochrome (a type of light receptor in plants and animals), blue ultraviolet radiation receptor [16].

2.2) Magnetic orientation system based on magnetic structure [17]: Magnetic orientation system based on magnetic structure, the presence of a type of bacteria with magnetic properties called Fe_3O_4 in the bee's abdomen that reacts to the magnetic field [17-19]. The Fe_3O_4 in the bee's abdomen allows it to sense slight changes in the Earth's field lines. If these delicate structures are affected by even the slightest magnetic pollution, it will disrupt the bee's orientation system [20].

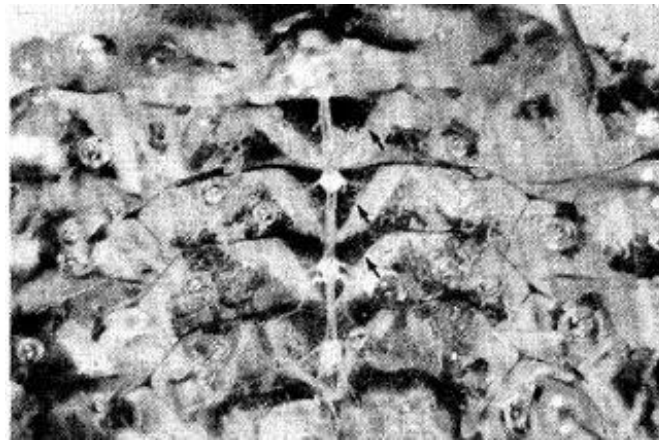


Figure 1. A view of the opened abdomen of a bee with cells with magnetic properties [18]

EMF electromagnetic fields, called electric smog pollution, are also known as one of the hidden and silent forms of pollution. Electromagnetic radiation (EMR) is widely used in modern technology and communication [21]. Radiofrequency and microwave pollution, caused by various sources of mobile phones such as GSM, and UMTS/3G, is an essential factor in reducing population. Insects are like honey bees [22, 23]. When worker bees leave the hive to collect food and never return to the hive, the phenomenon of CCD (Colony Collapse Disorder) occurs; this event occurs when the hive population suddenly disappears [24]. Some scientists believe that the new phenomenon of CCD is caused by electromagnetic radiation. Recent studies show that the death of many animals and insects, such as honey bees, birds, and amphibians, is caused by EMR field exposure [25-27].

Balmori's 2009 research on the effect of electromagnetic pollution from cell phone antennas on wildlife shows that microwave and radio frequency pollution has the potential to reduce animal and plant populations near cell phone towers. It becomes [28]. Scientists have measured and shown the signal transmitted by the bee in the standby and active modes of the mobile phone. Figure 2 shows that the mobile phone is in standby mode during pointer 1. The bees rested for approximately 10 minutes and produced sounds between 400 Hz and 500 Hz at standard frequencies. When indicator two is set to Active mode, the bees start to produce sounds in high frequencies. The frequencies reached the maximum frequency of 1520 Hz after 1150 seconds (19.16 minutes). At marker 3, the contact was interrupted, but the bees returned to a relaxed state for about 3.3 min after the contact was interrupted. At marker 4, the frequency transmitted by the bees begins to decrease. At marker 5, the bees were completely back to their resting state, and their frequencies ranged between 400 Hz and 500 Hz.

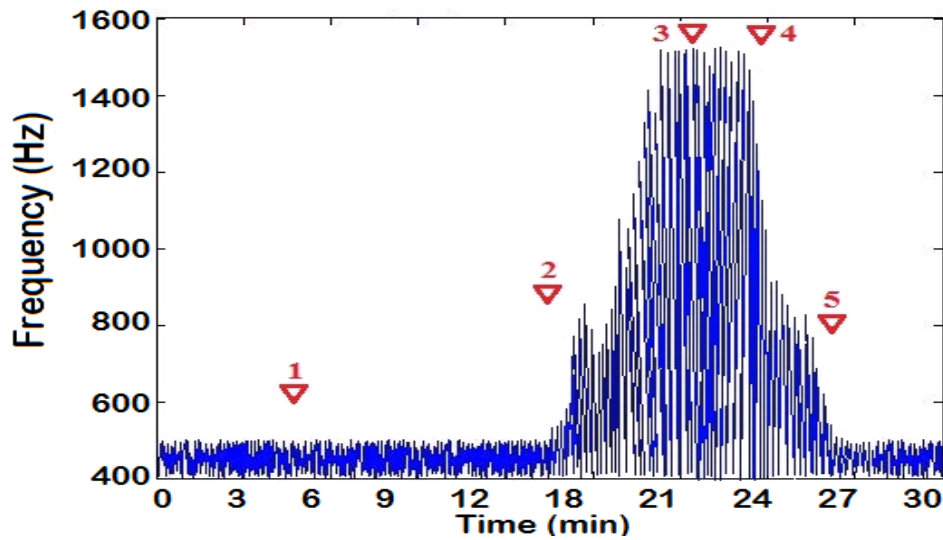


Figure 2. The signal transmitted by the bee in Standby and Active mode of the mobile phone [29]

The studies conducted by Sainudeen Sahib.S in 2011 on the effect of electromagnetic radiation (EMR) on bees show, to investigate this issue, six colonies of honey bees, three colonies as experimental colonies (T1, T2, T3), and the rest of the control sample. (C1, C2, C3) is selected [26]. Test colonies were exposed to mobile phones operating at 900 MHz for 10 minutes over ten days. The control colonies were not in contact with the cell phone. Research shows that worker bees in test colonies never returned to the hive after ten days. The results of this study are presented in Table 1.

Table 1. Changes in the state of the bee colony exposed to mobile phones [30, 31]

	Parameter	Control group (mean $\pm$ standard deviation)	Experimental group for 10 days
Number of worker bees that left the hive/min	Before calling	40.7 $\pm$ 15	38.2 $\pm$ 12
	During the call	41.5 $\pm$ 14	18.5 $\pm$ 13
	After the call	42.5 $\pm$ 14	

3- Fluorescent blue light and its effects on honey bees:

Like human eyes, honeybees have three types of light receptors in their compound eyes. Both share blue and green light receptors, but the third type is red for humans and ultraviolet (UV) for honey bees.

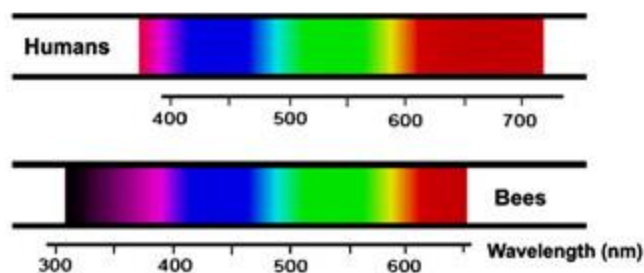


Figure 3. Comparing the spectral range of bee and human vision [32, 33]

Based on the research of Dr. Oksana Ostroverkhova, a professor in the Department of Physics at Oregon State University, blue fluorescent light is particularly attractive to honeybees. They also found that honey bees prefer fluorescent blue light in the 430-480 nm range compared to 400-420 nm [34]. This finding is considered a powerful tool for beekeepers and farmers. For example, if farmers need to pollinate their crops, they can use fluorescent blue light to attract bees for pollination; it can also be used as a tool to bring bees back to the hive.

The mentioned point can be considered and used in various artificial intelligence-based sciences and industries [35-39].

4- Conclusion:

The increase in telecommunication towers and mobile phones is a serious threat to reducing honey bees' population. The findings show that the drastic reduction in the honey bee population is due to environmental electromagnetic radiation (EMR), which is a warning for living organisms. The electromagnetic radiation produced by mobile phone towers disrupts the navigation system of honey bees, so they cannot find their way back to the hive. Our proposal to control the bee colony population is to use fluorescent blue light in the bee colony location.

Funding information: The authors received no financial support for this research, authorship, and/or publication.

Declaration of interests: The authors declares that there is no conflict of interest in this work.

Ethical approval: This article does not contain any studies with human participants or animals performed by the authors.

REFERENCES

- [1] Cheng DK. Field and wave electromagnetics: Pearson Education India, 1989.
- [2] Bozorgmanesh MA. Thermal Effects of Electromagnetic Waves on the Human Body. Islamic Azad University-Young Researchers and Elite Club First National Conference on Electrical Engineering (BPJCEE2016) Shiraz-Kazerun Branches2016.
- [3] Theerman P. James Clerk Maxwell: A Biography. JSTOR; 1984.
- [4] Kundi M, Hardell L, Sage C, Sobel E. Electromagnetic fields and the precautionary principle. *Environmental health perspectives*. 2009;117:A484-A5.
- [5] Pattazhy S. Electromagnetic radiation (EMR) clashes with honeybees. *Journal of Entomology & Nematology*. 2012;4:1-3.
- [6] Sivani S, Sudarsanam D. Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem-a review. *Biology and Medicine*. 2012;4:202.
- [7] Gallai N, Salles J-M, Settele J, Vaissière BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecological economics*. 2009;68:810-21.
- [8] Blank M, Goodman R. Electromagnetic fields stress living cells. *Pathophysiology*. 2009;16:71-8.
- [9] Liang C-H, Chuang C-L, Jiang J-A, Yang E-C. Magnetic sensing through the abdomen of the honey bee. *Scientific Reports*. 2016;6:1-7.
- [10] Ratnieks FL. How far do bees forage. *Bee improvement*. 2000;6:10-1.
- [11] Collett TS, Collett M. Memory use in insect visual navigation. *Nature Reviews Neuroscience*. 2002;3:542-52.
- [12] Gould JL, Kirschvink J, Deffeyes K. Bees have magnetic remanence. *science*. 1978;201:1026-8.
- [13] Hsu C-Y, Ko F-Y, Li C-W, Fann K, Lue J-T. Magnetoreception system in honeybees (*Apis mellifera*). *PloS one*. 2007;2:e395.
- [14] Kirschvink JL, Kirschvink AK. Is geomagnetic sensitivity real? Replication of the Walker-Bitterman magnetic conditioning experiment in honey bees. *American Zoologist*. 1991;31:169-86.
- [15] Johnsen S, Lohmann KJ. The physics and neurobiology of magnetoreception. *Nature Reviews Neuroscience*. 2005;6:703-12.
- [16] Gegebar RJ, Casselman A, Waddell S, Reppert SM. Cryptochrome mediates light-dependent magnetosensitivity in *Drosophila*. *Nature*. 2008;454:1014-8.

- [17] Kirschvink JL, Walker MM, Diebel CE. Magnetite-based magnetoreception. *Current opinion in neurobiology*. 2001;11:462-7.
- [18] Kuterbach DA, Walcott B, Reeder RJ, Frankel RB. Iron-containing cells in the honey bee (*Apis mellifera*). *science*. 1982;218:695-7.
- [19] Jaccoud El-Jaick L, Acosta-Avalos D, Motta de Souza Esquivel D, Wajnberg E, Paixão Linhares M. Electron paramagnetic resonance study of honeybee *Apis mellifera* abdomens. *European Biophysics Journal*. 2001;29:579-86.
- [20] Favre D. Mobile phone-induced honeybee worker piping. *Apidologie*. 2011;42:270-9.
- [21] Sarkar J. Wildlife around communication towers. *Current Science*. 2011;101:1403.
- [22] Everaert J, Bauwens D. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (*Passer domesticus*). *Electromagnetic biology and medicine*. 2007;26:63-72.
- [23] VanEngelsdorp D, Hayes Jr J, Underwood RM, Pettis J. A survey of honey bee colony losses in the US, fall 2007 to spring 2008. *PloS one*. 2008;3:e4071.
- [24] VanEngelsdorp D, Evans JD, Saegerman C, Mullin C, Haubruge E, Nguyen BK, et al. Colony collapse disorder: a descriptive study. *PloS one*. 2009;4:e6481.
- [25] Nicholls B, Racey PA. Bats avoid radar installations: could electromagnetic fields deter bats from colliding with wind turbines? *PloS one*. 2007;2:e297.
- [26] Sainudeen Sahib S. Impact of mobile phone on the density of Honey Bees. PDF) *Mun Ent Zool*. 2011;6.
- [27] Sharma VP, Kumar NR. Changes in honeybee behaviour and biology under the influence of cellphone radiations. *Current Science(Bangalore)*. 2010;98:1376-8.
- [28] Balmori A. Electromagnetic pollution from phone masts. Effects on wildlife. *Pathophysiology*. 2009;16:191-9.
- [29] El Halabi N, Achkar R, Abou Haidar G. The effect of cell phone radiations on the life cycle of honeybees. *Eurocon 2013: IEEE*; 2013. p. 529-36.
- [30] Bayati Chaleshtari N, Hosseini AS, Tamimi Z, Bohloul F. Pollution is caused by electromagnetic fields and their effect on birds. The 6th National Conference on Environmental Engineering. Iran2021.
- [31] Sahib SS. Electromagnetic radiation (EMR) clashes with honey bees. *International Journal of Environmental Sciences*. 2011;1:897-900.
- [32] Peitsch D, Fietz A, Hertel H, de Souza J, Ventura DF, Menzel R. The spectral input systems of hymenopteran insects and their receptor-based colour vision. *Journal of Comparative Physiology A*. 1992;170:23-40.
- [33] Avarguès-Weber A, Mota T, Giurfa M. New vistas on honey bee vision. *Apidologie*. 2012;43:244-68.
- [34] Ostroverkhova O, Galindo G, Lande C, Kirby J, Scherr M, Hoffman G, et al. Understanding innate preferences of wild bee species: responses to wavelength-dependent selective excitation of blue and green photoreceptor types. *Journal of Comparative Physiology A*. 2018;204:667-75.
- [35] Mobasseri S, Soltani H. Impact of driving style on fuel consumption. *Nature and Science*. 2013;87-9.
- [36] Mobasseri S, Soltani H. Traffic noise and it's measurement methods. *Advances in Environmental Biology*. 2014;8:1277-85.
- [37] Mobasseri S, Mobasseri M. A Comparative Study Between ABS and Disc Brake System Using Finite Element Method. *International Conference on Researches in Science and Engineering*. Istanbul University, Turkey2017.
- [38] Mobasseri S. Intelligent Circuit Application for Detecting the amount of Air in Automobile Tires. Iranian Patent, Patent2014.
- [39] Mobasseri S. Intelligent Circuit Application for Monitoring the Employees Attendance. Iranian Patent, Patent2014.