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PROACTIVE SANITARY-VETERINARY MONITORING OF BEE FAMILIES INCLUDED IN A PROPHYLAXIS PROGRAM (ACTIVE BEEKEEPING SEASON 2023)

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Abstract

The purpose of this work is to monitor the state of bee health through morphoclinical and laboratory examination of bees on samples of live bees and honeycombs with brood for the prevention and control of diseases in bees in order to include them in a study on the impact of the non-ionizing electromagnetic radiations on bees. Samples were collected during the active season 2023, and morpho-clinically and laboratory examined according to OIE regulations from 9 private apiaries (PH, AG, TR, CL, VN, IS, DB, VL and IF) from which we collected 18 samples. The laboratory results revealed the existence of some diseases in 6 apiaries (66.67%), as follows: a unique evolution (suspected foulbrood disease in one apiary) (11.11%), five apiaries with mixed conditions (55,56%) (varroosis, nosemosis, chalkbrood, and suspected poisoning), and three apiaries were diagnosed as clinically healthy (33.33%). Studying the influence of non-ionizing radiation on bees has wider implications for ecology and the environment, as bees play a crucial role in pollination and maintaining ecosystems. The interaction between bees and electromagnetic radiation is a complex and multifactorial issue that may explain the diversity of conclusions in the available studies. Therefore, studies are needed in Romania to better understand the connection between non-ionizing electromagnetic radiation and the decline of bee populations (*Collony Colapse Disorder*).

Key words: bees, private apiaries, monitoring, health

INTRODUCTION

Bees, being among the most important natural pollinators, play a crucial role in maintaining balance in natural ecosystems and ensuring agricultural production. However, they are frequently affected by a number of diseases that can threaten the health and survival of bee colonies (Alleri M., *et al*, 2023; Pattazhy S., 2011; Seker S.S., *et al*, 2022).

One of the main factors currently contributing to the outbreak of bee diseases is the stress caused by changes in their habitat, the intensive use of pesticides, malnutrition, electromagnetic radiation and other environmental factors that favor a decrease in immunity and the onset of various diseases (bacterial, fungal, viral, parasitical), including the colonies collapse disorder (Balmori A., 2014; Goudeseune L., *et al*, 2018; Treder M., *et al*, 2023; Watson K., Stallins J.A. 2016). Decreased pollination of wild plants can lead to increased population of plants that do not rely on pollinators, and decreased pollinators would lead to drastic declines in crop plants (Friesen M., Havas M., 2019; Gagnaire B., *et al*, 2019; Gawas A.U., 2015; Seker S.S., Simsek O., Brief 2022).

The concern about the impact of electromagnetic radiation on bees is part of a wider issue related to the potential impact of human activities on the environment and wildlife (Balmori A., 2015; Balmori A., 2021; Cammaerts M.C., Johansson O., 2014; Chiaraviglio L., *et al*, 2018; Cucurachi, S., *et al*, 2013; Dalio J.S., 2015; Formicki, K., *et al*, 2021; Friesen M., Havas M., 2019; Gagnaire B., *et al*, 2019; Gould J.L., 1989). This issue has gained increased attention in recent years as the implementation of new technologies such as 4G and 5G networks has led to increased exposure to electromagnetic radiation in many areas (Cucurachi S., *et al*, 2013; Field E., 2021; Goudeseune L., *et al*, 2018; Hasan H.J., et al, 2021; Jeladze V., *et al*, 2022; Korolev I.V., *et al*, 2022; Korolev I.V., *et al*, 2022; Seker S.S. *et al*, 2022).

There is no national level information on the current situation regarding the impact of electromagnetic radiation on bees in Romania, and therefore it is important to conduct research and monitor the impact of different sources of electromagnetic radiation, including 4G and 5G networks on bees and other pollinators, as they

play an important role in the ecosystem and in food production.

It is recognized that bees are important pollinators and play a critical role in maintaining biodiversity and food security. In recent years there has been increasing concern about the potential impact of various environmental stressors, including electromagnetic radiation, on bee populations and their health.

While some studies have suggested that exposure to electromagnetic radiation can have negative effects on bees (http://stop5gromania.ro/studii-ale-efector-radiatiilor-campurilor-electromagnetice-asupra-omului-animalelor-plantelor/; www. apc-romania.ro/ro/i-de-ce-ne-mor-albinele.htm; www.ncbi.nlm.nih.gov; www.youtube.com/ X5IhKHGDKhM), further research is needed to fully understand the extent of these impacts and to develop appropriate strategies to mitigate them or protect bee colonies through various screening devices.

In Romania, as in other countries, it is important to assess the potential impacts of electromagnetic radiation on bee populations and to implement measures to protect them. This may include monitoring bee populations, monitoring exposure to electromagnetic radiation, and conducting research to better understand the effects of these radiation sources on bee health (Favre D., Johansson O., 2020; Favre, D. 2017; Thielens A., *et al*., 2020).

The situation regarding the impact of electromagnetic radiation on bees is still a subject of ongoing research and debate in Europe and in the world. While some studies have suggested that exposure to electromagnetic radiation can have negative effects on bees, including changes in their behavior, flight and communication, the results of these studies have been unclear and are not yet definitive.

Some studies have suggested that exposure to electromagnetic radiation from sources such as cell phone towers (Odemer R., Odemer F., 2019; Panagopoulos D.J., 2019; Panagopoulos D.J., *et al.*, 2015) and Wi-Fi networks can have negative effects on bees, including changes in behavior and their ability to navigate (Bozorgmanesh M.A., Kowkabi F., 2019; Bozorgmanesh M.A., Kowkabi F., 2023; Favre D., 2011; Kumar N.R., *et al*, 2011; Kumar R., *et al*, 2021; Kumar, S.S., 2018; Seker S., *et a*l, 2022; www.apc-romania.ro; www.ncbi.nlm), other studies suggest that these effects are negligible or within normal limits for bees or find no significant impact on them.

Electromagnetic radiation comes from a wide range of sources (mobile communications networks, Wi-Fi, power lines and other electronic devices) that can affect the behavior, orientation and communication of bees, as they use orientation information in the electromagnetic spectrum to navigate and find food and hives (Abdelaal A., 2015; Balmori A., 2015; Balmori A., 2021; Greggers, U., *et al*, 2013; Hsu C.Y., *et al*, 2007). Exposure to radiation emitted by mobile phones can affect bees' ability to find and return to their own hive, negatively impacting colony activity and health (Bozorgmanesh M.A., Kowkabi F., 2019; Bozorgmanesh M.A., Kowkabi F., 2023; Favre D., 2011; Gawas, A.U., 2015; Gould, J.L., *et al*, 1989; Kumar N.R., Sangwan S., Badotra P., 2011; Kumar R., *et al.*, 2021; Kumar S.S., 2018; Sharma V. P., Kumar N. R., 2010; Treder M., *et al*, 2023; Watson K., Stallins J. A. 2016).

Overall, the situation regarding the impact of electromagnetic radiation on bees is complex and is an area that requires continuous research and monitoring. It is also important to ensure that these networks are used in a safe and responsible way and to assess the potential risks and impacts on human health and the environment (Adlienė D., *et al*, 2020).

Further research and monitoring is needed to fully understand the potential effects and to determine the best approach to mitigate any negative impact on bee populations and to inform policy makers in decision-making in Romania and other countries. It is also important for policy makers to consider the potential impacts of electromagnetic radiation when developing and implementing policies related to 4G and 5G networks and other sources of electromagnetic radiation, and to implement measures to protect bee populations and other important pollinators.

Despite ongoing research, there is still no clear consensus on the impact of electromagnetic radiation on pollinators. Currently, the scientific consensus is that more research is needed to fully understand the potential impact of electromagnetic radiation on pollinators. Some countries, including the European Union, have taken steps to monitor the development of 5G technology and its potential effects on the environment and pollinators, and have implemented regulations to limit EMF exposure in certain areas, such as around beehives and feeding grounds for bees to minimize potential risks to pollinators and other wildlife.

MATERIAL AND METHOD

The samples were collected in the active beekeeping season 2023, morphoclinically and laboratory examined according to OIE regulations (2008) and adapted in the Pathology Laboratory of

the SCSBB. We investigated collected samples from the experimental group consisting of none private apiaries (PH, TR, AG, IF, CL, VN, VL, IS and DB) (Figure 1) having a total of 412 bee families (*table 1*), from which 18 samples were collected (9 live bees' samples and 9 brood combs samples corresponding to each apiary) (*table 2*).

Figure 1. The locations where the monitored bee colonies are located (Experimental Lot)

Table 1.
Bee families from the private apiaries studied

EXPERIMENTAL LOT	NO. BEE FAMILIES
Apiary 1 (PH)	60
Apiary 2 (TR)	85
Apiary 3 (AG)	85
Apiary 4 (IF)	25
Apiary 5 (CL)	12
Apiary 6 (VN)	40
Apiary 7 (VL)	20
Apiary 8 (IS)	35
Apiary 9 (DB)	50
TOTAL	412

Table 2.
Number of samples of bees and brood combs collected from the private apiaries

EXPERIMENTAL LOT	Bee samples/apiary	Brood combs samples/apiary
Apiary 1 (PH)	1	1
Apiary 2 (TR)	1	1
Apiary 3 (AG)	1	1
Apiary 4 (IF)	1	1
Apiary 5 (CL)	1	1
Apiary 6 (VN)	1	1
Apiary 7 (VL)	1	1
Apiary 8 (IS)	1	1
Apiary 9 (DB)	1	1
TOTAL	18	

RESULTS AND DISCUSSIONS

The laboratory results revealed the existence of diseases in 6 private beehives (66.67%), as follows: a single disease (varroosis in one apiary) (11.11%), 5 apiaries with mixed diseases (varroosis, nosemosis, chalkbrood/petrified brood, suspicion of intoxication) (55.56%), and 3 apiaries were diagnosed as clinically healthy (33.33%) (*table 3, figures 2, 3, 4, 5, 6 and 7*).

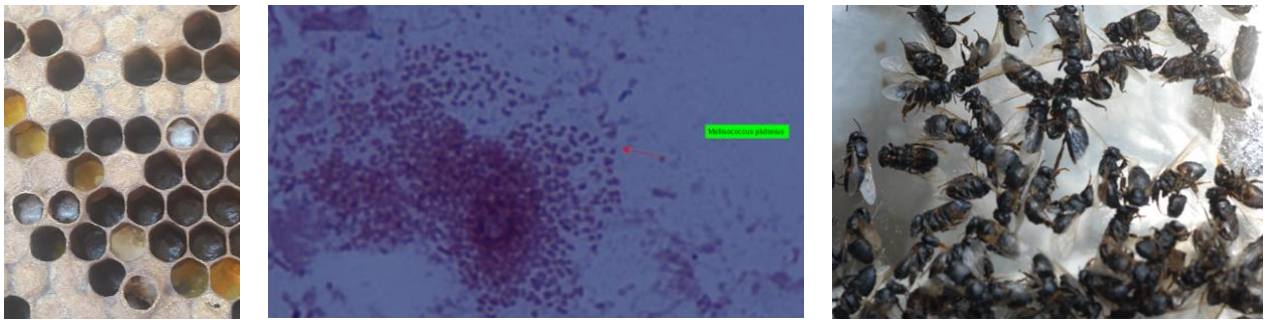

Figure 2. Mixed disease diagnosis (suspected European foulbrood and intoxication) to private apiary 1 (PH)

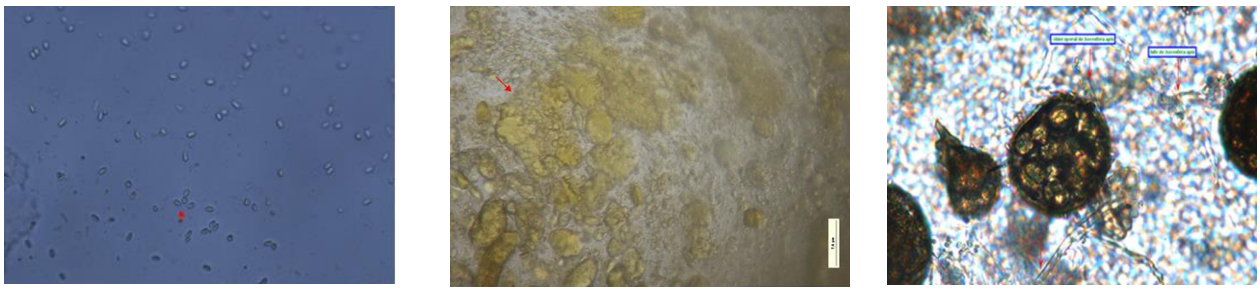

Figure 3. Mixed disease diagnosis (nosemosis + chalkbrood) to private apiary 2 (TR-1), Ascospheres with ascospores and hyphae of A. apis from the gut of a live bees (directly prepared, x 400)

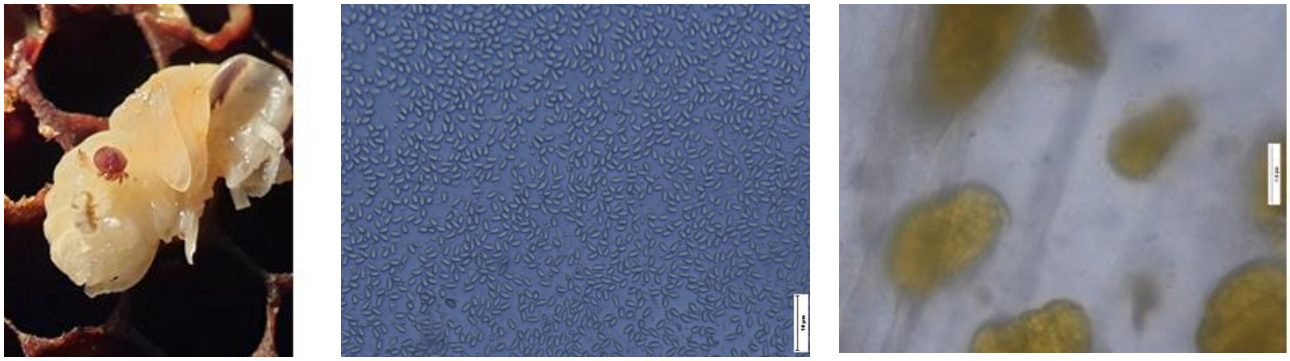

Figure 4. Mixed disease diagnosis (varroosis + nosemosis + chalkbrood) to private apiary 5 (CL)

Figure 5. Mixed disease diagnosis (varroosis + chalkbrood/petrified brood) to private apiary 7 (DB)

Figure 6. Diagnosis of varroosis (single condition) to private apiary 8 (IS)

Figure 7. Mixed disease diagnosis (varroosis + chalkbrood/petrified brood) to private apiary 9 (DB)

Table 3.
Diseases diagnosed in the studied private apiaries (Experimental Lot)

Private apiaries	Disease	Diagnosis
Apiary 1 (PH)	mixed	suspicion of European foulbrood and intoxication
Apiary 2 (TR-1)	mixed	nosemosis + chalkbrood
Apiary 3 (AG)		clinically healthy
Apiary 4 (IF)		clinically healthy
Apiary 5 (CL)	mixed	varroosis + nosemosis + chalkbrood
Apiary 6 (VN)		clinically healthy
Apiary 7 (VL)	mixed	varroosis + chalkbrood/petrified brood single varroosis
Apiary 8 (IS)	single	varroosis
Apiary 9 (DB)	mixed	varroosis + chalkbrood

CONCLUSIONS

The morpho-clinical and laboratory examination on live bees and brood comb, carried out in 2023 on 9 private apiaries (which will be included in an experimental study on the impact of non-ionizing electromagnetic radiation on bees), established the following: bee families from 3 apiaries were found clinically healthy (apiary no. 3, 4 and 6) (33.33%); diagnosis of a disease with a unique evolution in a apiary - varroosis (apiary no. 8), and mixed disease diagnosis in 5 apiaries (apiary no. 1, 2, 5, 7 and 9).

Studying the influence of non-ionizing radiation on clinically healthy and disease-affected bees has wider implications for ecology and the environment, as bees play a crucial role in pollination and ecosystem maintenance.

The interaction between bees and electromagnetic radiation is a complex and multifactorial issue, with numerous variables (radiation intensity, frequency and duration of exposure, types of radiation, health status, etc.) that may explain the diversity of conclusions from the available studies.

Therefore, studies are needed in Romania to better understand the connection between non-ionizing electromagnetic radiation and the decline of bee populations (*Colony Collapse Disorder*).

Compliance with ethical standards: The research does not involve human and/or animal experimentation.

Conflict of interest: The authors declare that they have no conflict of interest. We mention that the research conducted has no connection with the activity of official territorial or central laboratories nominated for the monitoring and control of bee diseases.

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www.http://stop5gromania.ro/studii-ale-efectelor-radiatiilor-campurilor-electromagnetice-asupra-omului-animalelor-plantelo**r/ (**Studii de specialitate cu privire la nocivitatea tehnologiei 5G-om, animale, insect/albine, plante)

w**ww.apc-romania**.ro/ro/i-de-ce-ne-mor-albinele/NjI5LTE.html

www.ncbi.nlm.nih.gov/pmc/articles/PMC6563664/ (Schimbări biochimice la albinele lucrătoare expuse radiațiilor unui telefon mobil Kumar Sangwan Badotra, Sibiu, 2019)

www.youtube.com/watch?v=X5lhKHGDKhM Dovezi ale nocivității extreme a implementării 5G **(**milioane de albine mor în zona antenelor 5G).