Bundesamt
für Strahlenschutz

**Spotlight on EMF Research**

# Spotlight on “Do electromagnetic fields used in telecommunications affect wild plant species? A control impact study conducted in the field” by Czerwinski et al. in Ecological Indicators (2023)

**Category [radiofrequency, plant study]**

Spotlight - Oct/2023 no.2 (Eng)

Competence Centre Electromagnetic Fields (KEMF)

## 1 Putting the paper into context by the BfS

The effects of electromagnetic fields on flora, fauna, and ecosystems are not extensively studied and there are open questions whether the limit recommendations developed for humans protect also animals and plants to the same degree. Well-designed experimental field studies on possible effects of radiofrequency fields, such as emitted, e.g., from mobile communications, on plants, are missing [2]. A possible methodological approach of such a study was suggested by the authors [3] and is now realized in the paper at hand [1].

## 2 Results and conclusions from the authors perspective

Czerwiński et. al [1] investigated the effects of radiofrequency electromagnetic fields (RF-EMF) in an experimental field study on plants commonly occurring in rural and suburban areas. They selected 10 different herbaceous plant species representing various plant families and different anatomical, morphological and physiological characteristics. All plant species were annual plants to enable the experiments being performed within one season. The plant species were identically distributed on two plots, one exposed and the other unexposed. For exposure, an RFID-based system was designed with the aim of applying simulated real-life conditions (frequency band: 869 MHz; 12.4 and 16.7 $mW/m^2$ on the exposed plot, 0.003 and 0.005 $mW/m^2$ on the control plot at a height of 20 and 40 cm above ground). Several parameters of plant growth and morphology were monitored for three months after germination based on photographs: plant height and shape, leaf area, leaf orientation and color.

All selected species germinated and reached maturity as normally developed plants: they reached their typical height and developed foliage. In four species, statistically significant differences between exposed and control plants were observed. In three species, the effects were observed only for one parameter at a single time point. Solely in hare's-foot clover *(Trifolium arvense)* more consistent effects were observed: after one month the exposed plants were taller, had a larger leaf area, a larger proportion of green leaves and the leaves were differentially oriented. After two and three months the picture changed: the exposed plants were smaller, had a smaller leaf area and a larger proportion of reddish leaves. The plants apparently underwent an earlier aging.

The authors discuss how the changed leaf orientation, a possible intensified photosynthetic activity, and natural environmental stressors, e.g., water deficit, wind and rain, could have contributed to the observed results. They conclude, that at least in some species, RF-EMF can cause permanent and irreversible effects in plants exposed to natural environmental stress. In most of the species, the effect of RF-EMF was weak, difficult to detect, restricted to a single parameter, or there was no response at all. The study does not provide an unambiguous answer to the question whether RF-EMF have serious ecological implications for wild plant communities. The authors recommend further research, especially in *Trifolium* species and other legumes.

# 3 Comments by the BfS

The presented study is the first experimental field study investigating the effects of RF-EMF on several herbaceous plant species over a longer time period. As knowledge about the effects of RF-EMF on plants is scarce, the topic has relevance for radiation protection as well as for the protection of the environment.

The study was performed according to a predefined, but not yet validated methodology. It was hypotheses driven. These aspects add value to the reliability of the results. The spectrum of 10 herbaceous species enables the evaluation of the effects at the level of plant community instead of focusing on just a single species.

Measurements at the site of the study area revealed EMF background levels below 3 µW/m² within a frequency range from 700 MHz to 6 GHz. No information is provided regarding the tilt of the Yagi antenna installed at 2 m height above the ground and used for exposing the plants. The ratio of the EMF levels of the exposed and control plot is reported greater than 34 dB and the average EMF levels of the exposed plot are reported in the order of magnitude of what can be expected in real life. EMF levels in the experimental area were measured twice during the five months lasting experiment and showed differences of up to 5 dB in local exposure levels between different corners of the exposed plot. No continuous EMF exposure level monitoring took place and no further information is provided with regard to the daily routine checks that were performed instead. The changes in local exposure levels over time, which amount to more than +3 dB and -4 dB at the corners of the plots respectively, are not discussed.

The study was not blinded. Therefore, a bias cannot be ruled out. It is difficult to blind field studies, but blinding the evaluator of the plant photographs would have been feasible and could have improved the study quality.

For statistical analyses, ANOVA with planned contrast was used. Two predictor variables – species and treatment (exposure) – were defined ad-hoc. The authors did not perform any post-hoc comparisons. Such an approach is known to help to reduce the risk of false positive results.

The margin of statistical significance was set to $p \leq 1.0$, resulting in statistically significant effects of RF-EMF in four out of ten plant species. At the more common value of $p \leq 0.05$ statistically significant effects were observed only in two instead of four species, both of them being legumes (Family *Fabaceae*).

The study is an important starting point for the assessement of posible effects of RF-EMF on plants from a radiation protection point of view. The study is well described and should be independently replicated. If confirmed, further experiments with legumes could possibly shed light on the underlying mechanisms.

# References

[1] Czerwiński M, Vian A et al. Do electromagnetic fields used in telecommunications affect wild plant species? A control impact study conducted in the field. 2023, Ecological Indicators 150. DOI: 10.1016/j.ecolind.2023.110267

[2] Pophof B, Henschenmacher B et al. Biological effects of radiofrequency electromagnetic fields above 100 mhz on fauna and flora: Workshop report. Health Phys 2023, 124: 31-38, DOI 10.1097/hp.0000000000001625

[3] Czerwiński M, Januszkiewicz Ł et al. The influence of bioactive mobile telephony radiation at the level of a plant community – possible mechanisms and indicators of the effects. 2020, Ecological Indicators 108: 105683. DOI: 10.1016/j.ecolind.2019.105683

**Impressum**

Bundesamt für Strahlenschutz
Postfach 10 01 49
38201 Salzgitter

Tel.: +49 30 18333-0
Fax: +49 30 18333-1885
E-Mail: spotlight@bfs.de
De-Mail: epost@bfs.de-mail.de

www.bfs.de

Please always use the following URN when citing this document:
urn:nbn:de:0221-2023111740454

Spotlight - Oct/2023 no.2 (Eng)