EFFECT OF LOW-FREQUENCY ELECTROMAGNETIC WAVES IRRADIATION ON MAIZE GERMINATION

Florin IMBREA, Branko MARINCOVIC, Valeriu TABĂRĂ, Paul PÎRŞAN, Gheorghe DAVID,Lucian BOTOS,

Banat's University of Agricultural Sciences and Veterinary Medicine, Faculty of Agricultural Sciences, Timisoara, Aradului Street, no. 119, RO-300645, Romania,
Corresponding author: ***imbrea_fl@yahoo.ca***

Abstract. *Research was carried out in the laboratory of „Agricultural produce quality analysis" of the Department of Agricultural technologies of the Faculty of Agriculture. The goal of the present paper is to valorise the beneficial effect this type of electromagnetic radiations has on seed germination and, later on, on plant growth and, last but not least, on the environment, through pollution decrease. The importance of the study comes from the fact that at present, in many countries of the world, there are researches being carried on that present the beneficial effect of these radiations on numerous field crops, such as: wheat, maize, sugar beets, potatoes, and peanuts; on green peppers, tomatoes, and strawberry; on vine; and in the field of plant microbiology and physiology. It has been proven so far that the same wave length cannot produce the same effect on all cultivars or hybrids of a species. It is also well known that, depending on the magnetic field of the experimental area, a certain wave length can produce a positive or negative effect, which determines the necessity of very laborious studies in order to establish wave lengths for each species (cultivar, hybrid) and the area. The working method used in the experiment is specific to determining germinative capacity, while in the treatment of the seeds we used the generator of electromagnetic radiations of the Faculty of Agriculture of Novi Sad thanks to Professor Branko Marinkovic. We should mention that we used in the treatment of the seeds only frequencies known to stimulate plant growth and measuring between 0 and 100 Hz. The support on which we sowed the seeds was quartz sand, and watering seeds was done with distilled water. The temperature in the laboratory was kept at 20-21^{O}C. The results of the present study are part of a research project PN II IDEI Contract nr. 1076/2009, topic code ID_864, financed by the Ministry of Education, Research, Youth and Sport, through the National Council of Scientific Research in Higher Education. The topic of the project is „Study concerning low-frequency electromagnetic waves effect on crop and quality in maize".*

Key words**:** *words, electromagnetic waves, germination, irradiation*

INTRODUCTION

The 20th century is noticeable, among other things, for the technical and technological revolution in all the fields of activity of the humans. This revolution would be inconceivable nowadays without the device generating electromagnetic radiations.

Through electromagnetic stimulation, one can enhance microbiological activity in the soil and the quantitative and qualitative features of the crops.

MATERIAL AND METHODS

We have used only frequencies known at present to stimulate plant growth and to improve produce quality. Frequency codification under study was done randomly, without observing the increase scale of the determined parameters. Studied frequencies ranged within low-wave frequency, i.e. between 0 and 100 Hz.

The duration of the treatment was 10 minutes. Sowing treated seeds was done right after the treatment was applied, knowing from previous research that seeds thus treated should be sown maximum 7-10 days after the treatment.

Sowing was done in boxes 30 x 20 cm. In a box we sowed 35 treated seeds, and each variant was sown in three replications.

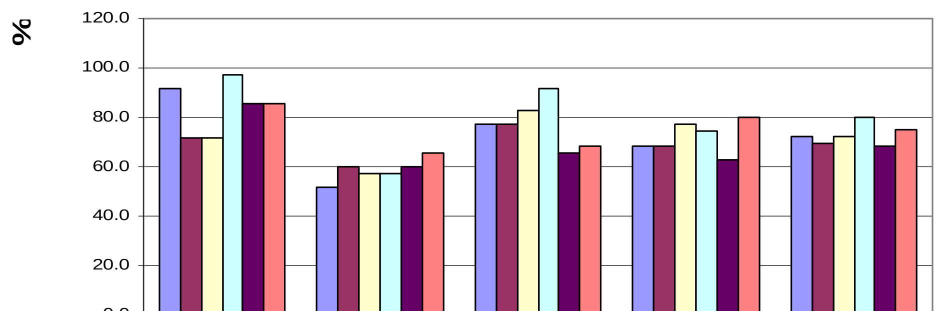
The support on which seeds were sown was quartz sand, and watering the seeds was done with distilled water. Laboratory temperature was maintained at 20-21^{0}C.

We monitored the effect of 5 different wave lengths compared to the control with the following measurements:

- germinating energy (%),4 days after treatment;
- germinating capacity (%) 7 days after treatment;
- root volume (mg) 7 days after treatment;
- root length (cm), 7 days after treatment;
- fresh root volume (g), days after treatment;
- length of aerial part (cm), days after treatment;
- dry aerial plant part volume (g), days after treatment;

RESULTS AND DISCUSSIONS

Figure 1 presents germinating energy (%) determined 4 days later, depending on the hybrid and treatment. As for the hybrids and the variant of treatment, the highest germinating energy was in the hybrid NS 300 (V4 -97.4%), followed by NS640 (V4 – 91.4%), while the lowest germinating energy was in the hybrid NS 444 (V1 – 51.4%). On the average for the five treatment variants, compared to the control (not treated), the highest share of germinating energy was in the variant V4 (80%), resulting in an increase of 5% compared to the control.

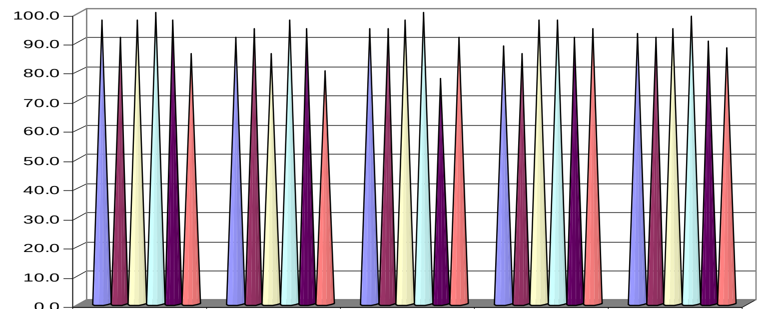


	NS300	NS444	NS640	PR37D25	Medie
V1	91.4	51.4	77.1	68.6	72.1
V2	71.4	60.0	77.1	68.6	69.3
V3	71.4	57.1	82.9	77.1	72.1
V4	97.1	57.1	91.4	74.3	80.0
V5	85.7	60.0	65.7	62.9	68.6
V6-control	85.7	65.7	68.6	80.0	75.0

Fig.1 Values of germinating energy (%) depending on hybrid and treatment variant

Figure 2 shows the results of germinating capacity depending on hybrid and treatment variant.

The highest share of the germinating capacity was in the hybrids NS 300 and NS 640, in the variant V4 (100%), while the lowest share of germinating capacity was in the variant NS444 (not treated). As for the share of the germinating capacity depending on the type of treatment, the highest percentage (98.6%) was in the variant V4, and the lowest one was in the control variant (87.9%).



	NS300	NS444	NS640	PR37D25	Medie
V1	97.1	91.4	94.3	88.6	92.9
V2	91.4	94.3	94.3	85.7	91.4
V3	97.1	85.7	97.1	97.1	94.3
V4	100.0	97.1	100.0	97.1	98.6
V5	97.1	94.3	77.1	91.4	90.0
V6-control	85.7	80.0	91.4	94.3	87.9

Fig.2 Values of germinating capacity (%) depending on hybrid and treatment variant

Root volume was calculated after 7 days, and results are presented in Figure 3. Data analysis shows that the largest volume was in the hybrid NS300 and in the variant V4 (1.36 cm^3). As for the root volume depending on the treatment variant compared to the control variant was in the variant V4 (0.93 cm^3), followed by V1 (0.91 cm^3), the difference compared to the control being 0.14 cm^3 and 0.12 cm^3, respectively.

Root length (cm) is presented in Figure 4. Data analysis shows that the longest root was in the hybrid NS 640, in the variant V1 (31.25 cm), while the shortest root was in the hybrid NS 444, in the variant V4 (16.16 cm). compared to the control (not stimulated electromagnetically), in four of the five experimental variants root length was 2.03 cm longer (V1), 1.59 cm (V2), 0.79 cm (V4), and 0.23 cm (V5). In the variant stimulated electromagnetically V3, the treatment inhibited root growth, so that on the average roots were 4.10 cm shorter.

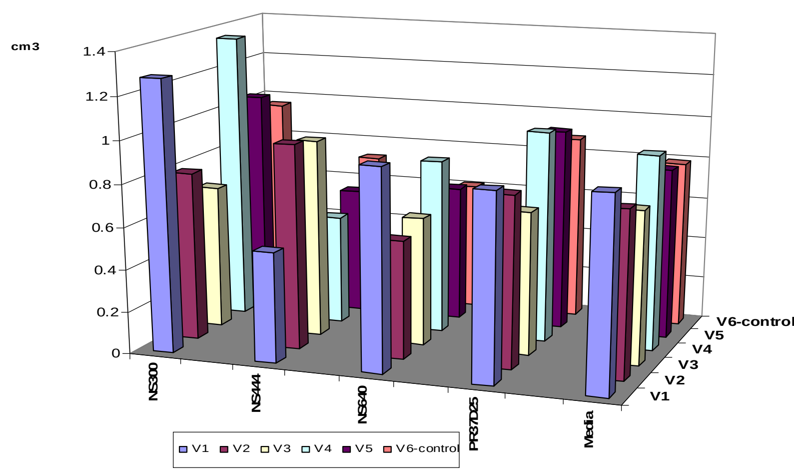
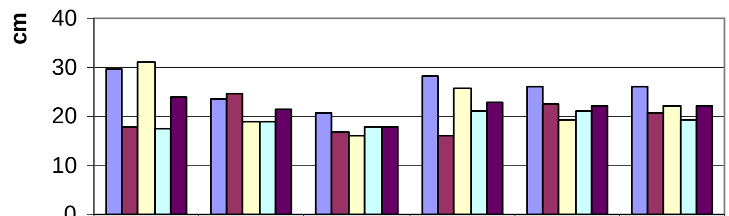


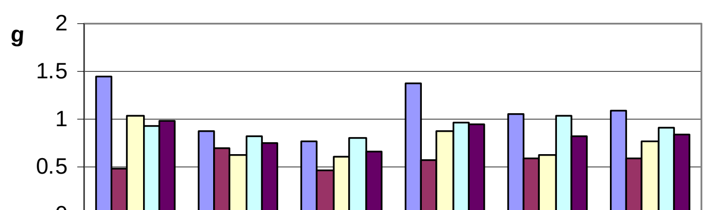
Fig.3 Root volume (cm^3) depending on hybrid and treatment variant



	V1	V2	V3	V4	V5	V6-control
NS300	29.6	23.75	20.7	28.2	26.2	26
NS444	17.88	24.75	16.9	16.16	22.36	20.6
NS640	31.25	19.04	16.2	25.8	19.37	22
PR37D25	17.4	18.8	17.8	21	21	19.4
Media	24.03	21.59	17.90	22.79	22.23	22.00

Fig.4 Root length (cm) depending on hybrid and treatment variant

Another indicator we monitored was fresh root volume (g) calculated after 7 days (Figure 5). Comparing the way experimental variants influenced fresh root volume, we can see that the largest volume of fresh root was in the variant V1 (1.45 g), in the hybrid NS 300, while the lowest one was in the variant V3 (0.46 g), in the hybrid NS 444. Analysing the variants of stimulation compared to the control (not treated) variant, the volume of fresh roots increased with 0.10 g in the variant V1, while in the variant V4 the increase was 0.11 g.

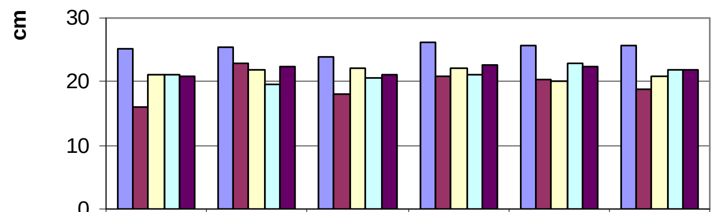


	V1	V2	V3	V4	V5	V6-control
NS300	1.45	0.87	0.76	1.38	1.05	1.09
NS444	0.49	0.69	0.46	0.57	0.59	0.59
NS640	1.03	0.62	0.6	0.87	0.62	0.77
PR37D25	0.93	0.83	0.8	0.97	1.04	0.91
Media	0.98	0.75	0.66	0.95	0.83	0.84

Fig.5 Fresh root volume (g) depending on hybrid and treatment variant

Results concerning the length of the aerial part (cm) determined after 7 days are presented in Figure 6.

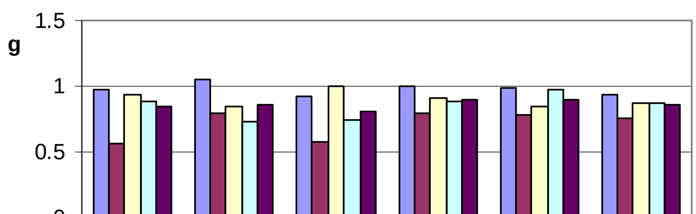
The stimulating effect of treating maize seeds with electromagnetic radiations is also obvious in the length of the aerial part. Thus, the longest aerial part was in the variant 4 (26.18 cm) in the hybrid NS 300. On the average for the five variants of stimulation, three of them (V2 – 22.49 cm, V4 -22.52 cm and V5 – 22.25 cm) yielded values higher than that of the control (21.83 cm).



	V1	V2	V3	V4	V5	V6-control
NS300	25.2	25.52	23.96	26.18	25.72	25.66
NS444	16.12	23	17.94	20.74	20.28	18.8
NS640	21.12	21.84	22	22.14	20.1	20.9
PR37D25	21	19.6	20.64	21	22.9	21.96
Media	20.86	22.49	21.14	22.52	22.25	21.83

Fig.6 Length of aerial part (cm) depending on hybrid and treatment variant

Results concerning the volume of fresh aerial part (g) measured 7 days after the treatment are presented in Figure 7. Compared to the control variants (not treated) (V4 and V5), there were increases of 0.4g.



	V1	V2	V3	V4	V5	V6-control
NS300	0.98	1.05	0.92	1	0.99	0.94
NS444	0.57	0.8	0.58	0.79	0.78	0.76
NS640	0.94	0.84	1	0.91	0.85	0.87
PR37D25	0.89	0.73	0.74	0.88	0.98	0.87
Media	0.85	0.86	0.81	0.90	0.90	0.86

Fig.7 Volume of fresh aerial part (g) depending on hybrid and treatment variant

CONCLUSIONS

As a conclusion, stimulating agricultural crops with low-frequency electromagnetic radiations results in certain increases from the point of view of the parameters analysed. We need to take into account the fact that all wave lengths have not a positive impact, hence the need to test more treatment variants to allow optimal choice of variants with positive effects on plant growth, yield, and quality.

BIBLIOGRAPHY

1. FLORIN IMBREA, PAUL PÎRȘAN, BRANKO MARINKOVIC, DAVID GHEORGHE, LUCIAN BOTOȘ, ADELA JURJESCU, (2009), Studies concerning the influence of radiations on biological features during imbibition and sprouting, Bulletin USAMV Cluj-Napoca-Agriculture, Vol 66 (1), pg. 571-575, Print ISSN 1843-5246; Electronic ISSN 1843-5386

2.MARINKOVIC B., (2001). Biophysical Stimulation and Its Effect on Soil Microbial Activity and Yields of Cultivated Plants, Proceedings od 3rd International Symposium Interdisciplinary Regional Research (Hungary, Romania, Yugoslavia), Part II, str.607-610, Novi Sad.

3.MARINKOVIC B., (2004). Ostvareni rezultati u ogledima i şirokoj proizvodnji biofizickih delovanja, Zbornik radova Naucnog instituta za ratarstvo i povrtarstvo, Novi Sad 6, str.187 - 198.