THE EFFECT OF ELECTROMAGNETIC WAVES ON MAIZE AND SUNFLOWER YIELDS

Ioana Maria CORODAN, Deiana NEȘIN, D. DICU

Banat`s University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, 119 Calea Aradului Street, 300645, Timisoara
ioana.corodan@yahoo.com

Abstract *Novelty and originality of the results can be appreciated both in terms of economic efficiency as well as the ease with which this method can be extended in daily practice, not required huge investments and to limit the extension to a larger number of growers, regardless of the cultivated area.The goal of the paper is to see the benefic effect of this type of electromagnetic radiations on plant growth and, last but not least, on yields and effect the environment. 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, and in the field of plant microbiology and physiology.In this paper we present the effect of 7 frequencies with wave lengths between 0-50 Hz on maize and sunflower yields comparative to the control. The duration of treatment was 10 minutes and sowing seeds treated realizing immediately after treatment, knowing that such treated seeds must be sown in maximum 7-10 days after making it. Measurements concerned the the level of maize and sunflower yields were carried out in the laboratory of „Agricultural produce quality Analysis" of the Department of Agricultural Technologies, Faculty of Agriculture of the Banat University of Agricultural Science and Veterinary Medicine "King Michael the Ist of Romania" from Timişoara, In the experiment, we used as genetic material the corn hybrids P9175, P9528, PR36V52, PR37N01, P9241, and sunflower hybrids P64LE19, P64LE25, P64LE20, ES Aramis, NK Adagio and in the treatment of the seeds we used the generator of electromagnetic radiations of the Faculty of Agriculture of Novi Sad. The improvement of the evaluated functional variables suggests that the seeds may perform better with an electromagnetic field treatment.*

Keywords: *maize, sunflower, radiation, frequency, treatment*

INTRODUCTION

The growing need for organic products, along with the increase of plant materials for food production, has led scientists to search for systemic factors to increase production, considering not only crop development by traditional methods, such as the use of fertilizers and agrochemicals which to some extent cause environmental damage, but also with the use of physical methods, such as the use of lasers, ultraviolet radiation, electromagnetic fields and electricity.

These physical methods are safe for the environment and frequently change the course of some physiological and biochemical processes in the seeds, which translates into increased vigor and improved plant development at later stages.

The effects of low frequency electromagnetic fields on plant growth are not yet clear and may be different depending on magnetic frequency, shape and intensity of the waves or the biological species in question.

The electromagnetic stimulation can increase soil microbiological activity and quantitative and qualitative properties of crops.

The positive effect of electromagnetic pulses to stimulate germination and plant growth is not only caused by the induced current,but probably explained by resonance. So, is

explained the effects obtained at plants by interaction of cellular systems stimulate with electromagnetic pulses that occur of the level of intracellular signals.

Today, it is known that the application of magnetic fields of extremely low frequencies positively affects some characteristics of plants and processes, such as seed germination, shoot development, plant length, fresh weight, fruit production and mean fruit weight.

The positive effects of magnetic fields have also been shown in the biosynthesis of proteins, cell production, photochemical activity, respiration rate, enzyme activity and nucleic acid content.

MATERIALS AND METHODS

The research was done at the Banat's University of Agricultural Science and Veterinary Medicine ''King Michael the I^{-st} of Romania'' from Timisoara.

In this study will be presented the effect of 7 electromagnetic wave with low frequency, which is between 0-50 Hz on maize and sunflower yields. The duration of treatment was 10 minutes for each hybrid, hybrids were sown immediately after treatment, because it is known that hybrids should be sown after 7-10 day after treatment.

The experiment was conducted in field, in OSPA Timisoara Experimenatal Center at Sanandrei. For the tratament was used the generator of electromagnetic radiations of the Faculty of Agriculture of Novi Sad, Serbia.

For the research, as biological material were used five maize and sunflower hybrids, that are used on a large area in the west of the country.

Maize hybrids used are represented by P9175, P9528, P9241, PR37N01, PR36V52.

Sunflower hybrids used are represented by P64LE19, P64LE20, P64LE25, ES Aramis and NK Adagio.

RESULTS AND DISCUSSIONS

Since hybrids were sown in the Experimenatal Center from Sanandrei , located at 12 km away from Timisoara city, we present in the following climatic conditions and characteristics of soil.

To characterize the specific climatic conditions for agricultural years 2014-2015, were used data recorded by OSPA Timisoara at Sanandrei Experimenatal Center. The Experimental Center is located on Route 56 Timisoara – Arad, km 15.4).

Table 1

Average monthly precipitation, annual (2014-2015) from Experimental Center Sanandrei and multianual in the range 1931-2015 (mm) at weather station Timisoara

Agricol year	Montly												Yearly
	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
14-15	68.5	72.5	8.0	32.0	27.0	9.0	24.0	29.0	60.5	32.2	16.5	61.5	441
normal	46,1	54,8	48,6	47,8	40,9	40,2	41,6	50,0	66,7	81,1	59,9	52,2	629,9

Differences

Agricol year	Montly												Yearly
	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
14—15	+22.4	+17.7	-40.6	-15.8	-13.9	-31.2	-17.6	-21	-6.2	-48.9	-43.4	+9.3	-188.9

The table shows that in September, October and August was recorded a higher rainfall quantitys from the annual average. The period from November to July is characterized by an drought agricultural year of 2014-2015.

To assess the impact of weather conditions on land productivity in the two stationary, the data were compared with significance of rainfall (reference limits in relation to the requirements of agriculture, (table 2) using data from agro-climatic resources of Timis County.

Table 2

The significance of rainfall
(the reference limits range with the agriculture requirements)

Interval	Semnification of rainfall quantityes				
	Very dry	Dry	Satisfactory	Optimal	Excedentary
September-octomber	Under 40	41-60	61-80	81-150	Over 150
November-march	Under 100	101-150	151-200	201-300	Over 300
Apil	Under 20	21-30	31-40	41-70	Over 70
Mai-july	Under 100	101-150	151-200	201-300	Over 300
Annual	Under 350	351-450	451-600	601-700	Over 700

Table 3

The significance of rainfall
range with the agriculture requirements at Sanandrei

Agricol year	Characteristic intervals									
	IX-X	Semnif.	XI-III	Semnif.	IV	Semnif.	V-VII	Semnif.	Anual	Semnif.
14-15	141	Optimum	100	Dry	29.0	Dry	109.2	Dry	441	Dry

It should be noted that in September and October rainfall is at an optimum, following that in the monthly interval November – March rainfall is much lower compared to the multiannual average and it gets to be a dry period. Also in April ar inrecistated small amounts of rainfall. In the period from May to July rainfall is very low, resulting another dry period.

How in the agricultural year 2014 – 2015 it was recorded with very small amounts of rainfall , and the dry period dominated much of the year, we can observd that the agricultural year 2014-2015 was a dry one , with a shortage of 188.9 mm.

At the experimental center of OSPA Timisoara from Sanandrei, the experiences are located on a on molic reddish preluvosoil, medium clay loam / medium clay loam, dominant in Plain Vinga and representative of a surface significant in Banato-Crisana Plain (Table4)

Table 4

The physical and chemical properties of the haplic luvisol from Sanandrei

Analitical indices	Depth (cm)							
	0-17	17-30	30-47	47-65	65-90	90-120	120-150	150-200
Coarse sand (2.0 – 0.2 mm)	0.6	0.7	0.5	0.7	0.7	1.3	1.2	1.1
Fine sand (0.2 – 0.02)	36.9	36.9	34.9	36.0	37.3	34.7	34.2	35.1
Silt (I + II) (0.02-0.002 mm)	27.9	25.2	25.2	25.6	25.0	23.9	21.2	21.7
Coloidal clay (sub 0.002)	34.6	34.5	39.4	37.7	37.0	40.1	43.4	42.1
Phisical clay (praf II +arg col)	46.5	47.5	50.7	49.8	49.5	52.3	51.3	52.0
TEXTURE	TT	TT	TT	TT	TT	TT	TT	TT
Specific Density (Ds)	2.56	2.57	2.59	2.59	2.60			
Aparent density (Da)	1.45	1.64	1.61	1.59	1.66			
Total phorosity (PT)	43.36	36.19	37.84	38.61	36.15			

Aeration phorosity (Pa)	9.47	-2.12	-0.27	1.15	-2.89			
Higroscopical coefficient(CH)	14.38	28.51	26.51	24.52	29.16			
Fadind coefficient (CO)	8.11	8.09	8.23	8.83	8.67			
Field capacity (CC)	12.16	12.13	13.84	13.25	13.00			
Total capacity (CT)	23.37	23.36	23.67	23.56	23.52			
Utile water capacity (CU)	11.21	11.23	9.83	10.31	10.52			
pH in water	5.46	5.87	6.15	6.77	6.95	8.13	8.22	8.16
Carbonates ($CaCO_3$)						5.67	6.09	3.57
Humus	2.28	1.59	1.41	0.42				
Humus reserve t/ha	56.20	33.90	38.59	2.00	**130.69**			
Mobile phosphorous (ppm)	15.0	13.4	12.0	10.9				
Mobile potasium (ppm)	131.8	87.8	74.7	72.9				

Morphological and micro-morphological characteristics of the soil profile (Tab. 4) are the result of pedogenesis processes, specific to steppe bioaccumulation, with the following essential characteristics: loamy clay texture, grainy structure in Am, washing salts including carbonates at relatively large depths (up to 100 cm) , weak acidifying the top of the soil.

The study of morphogenetic soil profile and the research of analytical determinations sheets, it have the specified characteristics, with the profile type: Ap-Atp-Am-A/B – Bt - B/C – Ck.

Among the chemical characteristics that influence the composition and way of life of ecosystems and have an important role in soil fertility are important: reaction, calcium carbonate content, humus content, cationic exchange indices, nutrient insurance status, etc.

The lower of pH value – in the processed layer (moderately acidi pH =5.46) and in the range of 30-65 cm (pH 5.87 to 6.77 weakly acid) shows a very marked decrease caused by repeated fertilization with acid fertilizers. In the depth ranges, the pH values are between 6,95-8,22.

The content of calcium carbonate is absent in the range 0-90 cm, after which, on the basis of the soil profile, has medium values, as can be seen from the data presented in table (Table 1).

The base saturation degree, although the coating processing, in the case of the profile sought, have the value of 78.8%, record the soil for the whole class of eubazic values.

The content of humus, or organic matter is one of the fundamental characteristics that define soil fertility status.

So, depending on particle size composition and mineralogical characteristics, the humus content of the profile studied (Tab. 4), has low values in 0-30 cm interval, very small values in 30-47cm range and extremely low between 47-65 cm. Extending over a relatively large thickness of humus in the soil profile, results a midle reserve of humus in the first 50 cm, about 130 t / ha.

Since the quality of the humus depends mainly on the reaction condition, namely, base saturation degree of the soil, has been developed a so-called nitrogen index (IN) which is in the form of the product of the humus content and base saturation degree, both expressed in percent.

The nitrogen index value indicating a poor state to supply in the range 0-47 cm. P_2O_5 and K_2O content, as the main macronutrients of soil, determine the real potential and fertility level at a time. Regarding the content of phosphorus, the profile sought, it has values indicating a low content in the range 0-65 cm. Potassium is found in soil in small quantities between 17-65 cm and have good values in the processed horizon (Ap, 0-17cm).

In the investigated profile the density has medium values (ranging between 2.56 and 2.60 g/cm^3) indicating an bioaccumulation (relatively uniform) throughout the soil profile (Table 1)

Regarding bulk density (DA), the values are between 1.45 (middle) and 1.66 (high), being in good measure a resulting of compressed anthropogenic influences (Atp with value of 1.64), or pedogenesis phenomena of subsidence in clay illuviated horyzons (Bt with values of 1,66).

On a background of porosity were prevails medium and very fine pores appear negative situations with very low values of total porosity in first 20 cm layer (Atp with values of 36.19%) and argic Bt horizon (36.15%). In such cases, the movement of water and air are much hampered, which reflects negatively on the hydro-physic characteristics of soil.

Regarding the degree of compaction, the values indicates a moderately compacted soil layer processed in Ap (0 -17 cm), after which the soil is heavily compacted to 90 cm.

The effect of stimulation with low frequency electromagnetic waves was also pursued and the level of production and the results on the level and quality of crops confirms the importance and applicability of this method. In the chart below it shows the maize crop yields, depending on the wavelength experimental and hybrid.

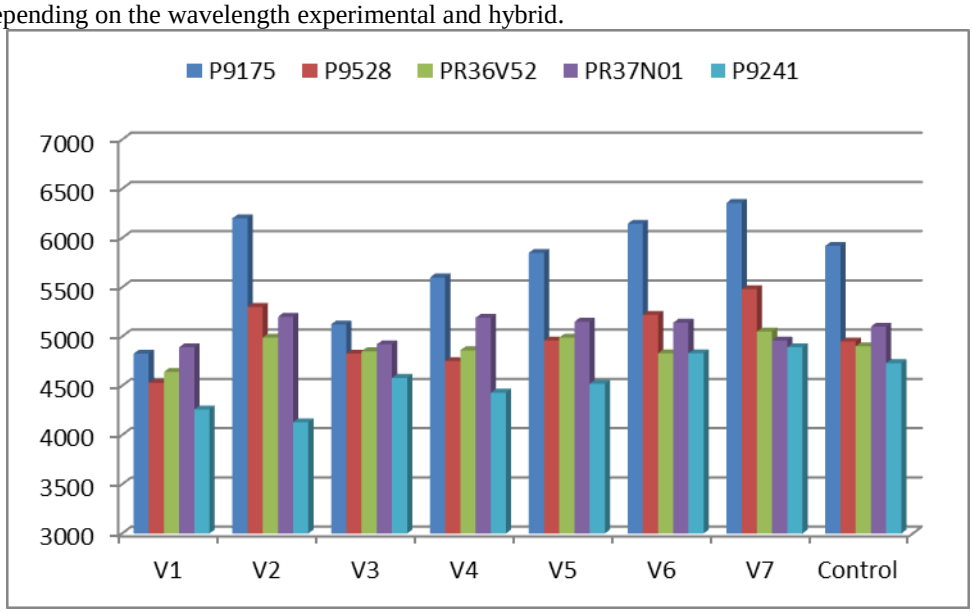

Fig. 1 Crop yields in maize (kg / ha), depending on the hybrid and treatment data

From the analysis of the datas, the yields obtained were between 4130 kg / ha (version V2 hybrid P9241) and 6360 kg / ha (version V7, hybrid P9175). Regarding the effect of electromagnetic stimulation, improve yields compared to control irradiated ranged PR37N01 între140 kg for hybrid and 438 kg (if the hybrid P 9175).

It is noted that the hybrid P9175 recorded a difference of 438 kg / ha compared to control. The hybrid P9528 achieved a yield of 530 kg/ha higher than the control. The hybrid

PR36V52 had a harvest of 150 kg/ha more than the control and hybrid P9241 get a good crop , with a difference of 160 kg / ha compared to the control sample.

It can be seen from the graph that the best yields were obtained for P9175 hybrid with an average of 5728 Kg/ha. The worst harvest being obtained whit P9241 hybrid. To calculate the average production, control sample was not introduced into the calculation.

The sunflower crop yields ranged from 2650 kg / ha (version V2, hybrid P64LE25) and 3180 kg / ha (V6 hybrid ES Aramis). Regarding the effect of electromagnetic stimulation, improve yields compared to control ranged from 100 kg in the case of ES hybrid Aramis to 260 kg (if the hybrid P 64 LE19).

It is noted that the hybrid P64LE25 has a difference of 170kg / ha compared to control. The hybrid P64LE20 achieved a yield of 120 kg/ha higher than the control and hybrid ES Aramis had a harvest of 100 kg/ha more than the control.

P64LE19 hybrid had the best production in V6 version , it has an average of 2990kg /ha , and a difference of 120 kg / ha compared to the control.

The hybrid NK Adagio had the best production variant V7 , with a production of 3150 kg/ha , with a difference from the control 160 kg/ha

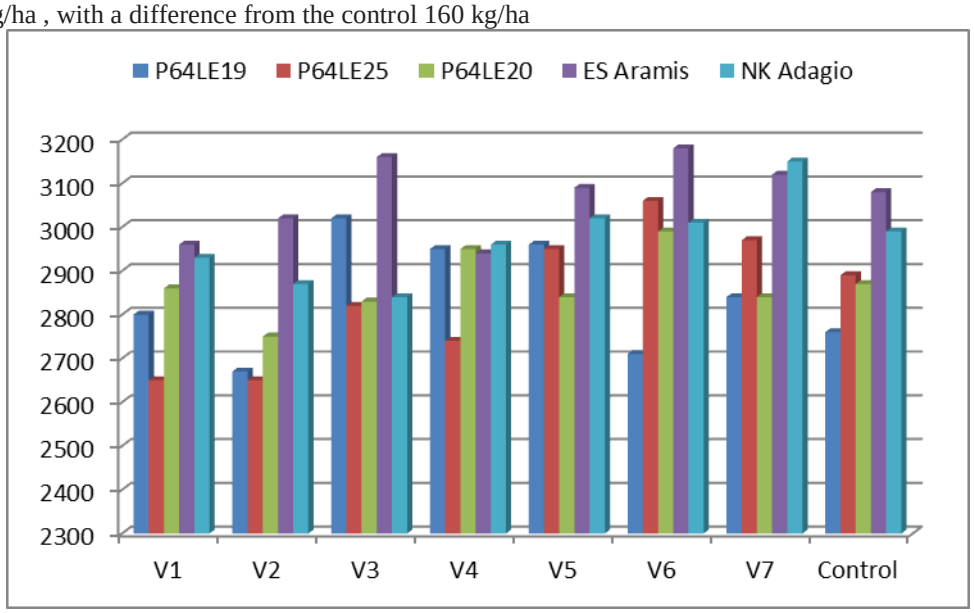

Fig. 2 Crop yields at sun flower (kg / ha), depending on the hybrid and treatment data

It can be seen from the graph that the best yields were obtained for ES Aramis hybrid with an average of 3068 Kg/ha. The worst harvest being obtained whit P64LE25 hybrid, with an average of 2834 kg/ha. To calculate the average production, control sample was not introduced into the calculation.

CONCLUSIONS

Stimulating agricultural crops using low frequency electromagnetic radiation causes some gains in terms of analyzed parameters.Not all wave lenghts influence positively,for

which,in the future should be tested more treatment options in order too choose optimal variants.

Along with the particularity of ecopedologic profile, the hydric resource as environmental factors (of the atmosphere), is found in production levels that were statistically assured in the two years of experimentation, for reddish molic preluvosoil fromVinga Plain.

The results reveal that the actual effect of rainfall on crops is influenced by soil properties (texture, porosity, permeability, useful water capacity) and relief, traits which may favor the accumulation, storage and disposal of water from differentiated precipitation.

Also, as seen from the research and in terms of behvior of hybrids, are clear differences. Experimentation of the new technologies of cultivation of maize is an important step tpo optimize production capacity of maize hybrids to be introduced into the culture.

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