Ultra low frequency electromagnetic field in function of rapeseed yield

Branko Marinkovic[1], Radovan Marinkovic[2], Ana Marjanovic-Jeromela[2], Jovan Crnobarac[1], Miroslav Grujic[3], Goran Jacimovic[1]

[1] *Faculty of Agriculture, Square Dositeja Obradovica 8., 21000 Novi Sad, Serbia,*
[2] *Research Institute of Field and Vegetable Crops, Maksima Gorkog 30., 21000 Novi Sad, Serbia,*
[3] *Gama-Trade GMK, V. Tomanovica 10., 11000 Belgrade, Serbia. Email: branko@polj.ns.ac.yu*

Abstract

Ultra low electromagnetic field can have stimulant effects on the yield and quality of cultivated plants. Effects of four ultra low frequencies on yield and quality of three-winter rapeseed cultivars (Banacanka, Pronto and Falcon) were studied in this paper work. In preliminary tests optimal frequency was found for each cultivar. Just before sowing, seed was treated with the best selected four frequencies.

Grain yield of cultivar Banacanka on variants (frequencies) 7 and 11 in average were increased for 23.1%, refer to variant without electromagnetic treatment (control). Mass of 1000 grains, in average for all treated variants, was higher for 0.56 g in relation to control, oil content was lower for 0.14% and test weight was at the control level.

Cultivar Pronto showed the best results in grain yield at variant 13 (in relation to control: +16.9%), and difference between oil percentage was 1.82% (at variant 16). The rest of the parameters were at control level.

Least marked effects of the electromagnetic field treatment were on Falcon cultivar. Yield increasing in average was just 1.39% and mass of 1000 grains at treated variants was higher for 0.07 g refers to control. Oil content and test weight were at the control level.

Key words: rapeseed, electromagnetic stimulation, yield, oil content.

Introduction

Biophysics is a young science dealing with biophysical and energy-information related processes in living beings. It is going to put fresh perspectives on things, change man's view of the world around him, and enable him to communicate with living beings based on principles they themselves are built upon. Colossal discoveries have been made in this field. The task of biophysics is not only to explain plant and animal response to biophysical action but also to secure replication of positive effects, therefore enabling us to better understand and communicate with plants.

The effects of biophysical action on cultivated plants are of primary importance for agriculture. Unlike the application of chemicals, which often negatively affected the environment, the introduction of biophysics into agriculture represents man's unification with natural processes based on nature's own principles[6.]

Radiation, in physical sense, presents stream of particles or quantitative energy. Unique effect of all types of radiation is their interaction with the environment through which they pass. Real deposition of radiation energy is performed on microscope level, so their recipient are macromolecular cell structures (molecules of DNA and proteins), intra and extra cellular liquid as well as other cell elements. Biological effect of radiation is realized in two ways: directly and indirectly. Direct effect of radiation is a consequence of interaction or split of chemical bounds between biological molecules with the radiation energy; indirect effect is result of production of highly reactive chemical compounds as a consequence of radiation on cell and inter-cell bounded water.

What is the final consequence depends on a series of factors that can be grouped according to radiation and the factors that are bound to biological characteristics of molecules, cells, tissues and organism as a whole.

Electromagnetic processing directly affects the activation of the enzyme complex in seeds and plants, the formation of free water molecules and the overcoming of resistance during the transport of energy and reduces the intensity of degradation of synthesized organic staff, therefore increasing yields and improving the quality of the product.

Looking at the probable mechanisms of the impact of an EMF on biological systems, we started from the premise that one of the processes most sensitive to external agents is the transitions of different proteins, in particular peripheral, from the membrane-bound state to the aqueous medium. Such undirected processes occur at certain stages of release of the seeds from the resting state. Transitions of proteins, because of the rise in the number of degrees of freedom for the protein groups in an aqueous medium and, accordingly, the entropy of the system, must be related to minor change in free energy[1]. They may be caused by local changes in pH or ionic strength or the concentration of Ca^{2+} ions sensitive to the influence of the EMF. The modeling data showing that the EMF effects in the low-frequency region may be significantly enhanced through non-linear processes in the near-membrane layer[2].

These processes depend on the state of the organism, which cannot always be controlled; in the organism a host of different processes occurs in parallel and these may react in different directions to an EMF possibly with other unheeded weak influences etc., reducing the reproducibility of the data and their reliability. Therefore, an important role is played by the choice of the objects for the investigations and the conditions for running them, which would limit the influence of such factors. The design of the experiment and the measured indicators must also be correlated with the possibility of verifying the particular models of the influence of an EMF on biological processes[1].

Data and methods

The trial was conducted at Rimski Sancevi, experimental field of the Research Institute of Field and Vegetable Crops (Novi Sad, Serbia), on soil type chernozem. Chernozem is a soil with a thick mollic or chernic horizont following by a calcic or gypsic horizont. The chernic horizont is a tangled mass of faecal material of earthworms or enchytraeid worms. Most chernozems have large passages (crotovinas) caused by burrowing vertebrates. Chernozem is developed mainly in calcareous loess and thus has a high nutrient status. It also has an excellent structure and high water-holding capacity which together impart a high natural fertility. This probably makes it the world's most important agricultural soil.

Three-winter rapeseed cultivars (Banacanka, Pronto and Falcon) were studied in this paper work along with the influence of ultra low frequencies at seed yield, yield components (mass of 1000 grains and test weight) and seed oil content.

Electromagnetic seed processing, by using method Resonant Impulse Electromagnetic Stimulation (RIES)[7], was done a day before sowing of seeds. For electromagnetic processing was used generator of impulse wave (0-100Hz, with accuracy at 0.01 Hz), aerial, energy source (storage battery 12V, 124Ah) and for controlling and guidance a lap top computer.

Effects of selected four ultra low frequencies (assigned as 7, 11, 13 and 16) were studied at each cultivar. Trial was sowed in optimal date (in both years; 2002 and 2003). Fertilizing and the others practical measures was done time-lineally and optimal for rapeseed production. At the end of vegetation, seed yield (kgha^{-1}), mass of 1000 grains (g), test weight (kg) and oil content (%) were measured.

Gained results were processed with factorial trial variance analysis.

Results and Discussion

Results with cultivar Banacanka are shown in table 1. At all tested variants with electromagnetic treatment increasing of seed yield was accomplished.

Statistically significant yield increasing was achieved at variants 7 and 11; it was 407 (21.8%) and 457 kgha^{-1} (24.4%). At the others two variants there was no statistically significant increasing (269 and 349 kgha^{-1}).

Mass of 1000 grains was significantly increased at all variants, and increasing was from 0.48 to 0.59 g (15.3-18.8%).

Oil content was increased at variants 7 (1.07%), 13 (1.09%) and 16 (0.35%). These results however weren't statistically significant. At tested treatments there were no significantly test weight changes.

Tab. 1. Yield (kgha^{-1}), components of yield and oil content of Banacanka cultivar

Variants		Yield (kgha^{-1})	Difference	Mass of 1000 grains (g)	Difference	% of oil	Difference	Test weight (kg)	Difference
Control		1869		3,13		44,68		67,0	
7		2276	407	3,69	0.56	45,75	1.07	66,8	-0.2
11		2326	457	3,72	0.59	41,62	-3.06	66,6	-0.4
13		2138	269	3,61	0.48	45,77	1.09	66,5	-0.5
16		2218	349	3,72	0.59	45,03	0.35	66,2	-0.8
LSD	005	378		0,28		4,88		0,5	
	001	512		0,38		6,61		0,6	

Seed yield at Pronto cultivar (table 2) was statistically increased only at variant 13 (408 kgha^{-1}, or 16.9%). At the others variants yield was smaller refer to control, but that differences was not statistically significant.

Mass of 1000 grains in refer to control was increased at variants 11 and 13 (2.86 and 0.57%), but that difference was not statistically significant. At variant 7, mass of 1000 grains was smaller referring to control. Oil content at all treatments was higher referring to control, but statistically significant increasing was only at variant 16 (1.82%). The test weight was equable at all variants and control.

Tab. 2. Yield (kgha^{-1}), components of yield and oil content of Pronto cultivar

Variants		Yield (kgha^{-1})	Difference	Mass of 1000 grains (g)	Difference	% of oil	Difference	Test weight (kg)	Difference
Control		2414		3,49		44,35		67,6	
7		2222	-192	3,39	-0.10	45,54	1.19	67,6	0.0
11		2131	-283	3,59	0.10	44,79	0.44	67,7	0.1
13		2822	408	3,51	0.02	44,66	0.31	67,7	0.1
16		2397	-17	3,49	0.00	46,17	1.82	67,4	-0.2
LSD	005	404		0,22		0,83		0,3	
	001	589		0,30		1,13		0,4	

Reaction of the Falcon cultivar on resonant impulse electromagnetic stimulation was minimal and there was no statistically significant yield increasing. At variants 13 and 16 yield increasing was only 58 kgha^{-1} and 180 kgha^{-1}. At variants 7 and 11 yield was decreased for 41 $kgha^{-1}$ and 91 $kgha^{-1}$.

Mass of 1000 grains was statistically higher on variant 13 and increased for 0.27 g (8.06%), and at variant 16 (0.23g, 6.9%). Oil content at variant 16 was increased in refer to control for 0.63%. Test weight was at control level.

Tab. 3. Yield ($kgha^{-1}$), components of yield and oil content of Falcon cultivar

Variants		Yield ($kgha^{-1}$)	Difference	Mass of 1000 grains (g)	Difference	% of oil	Difference	Test weight (kg)	Difference
Control		1900		3,35		45,23		67,9	
7		1859	-41	3,18	-0.17	45,12	-0.11	67,5	-0.4
11		1809	-91	3,28	-0.07	44,81	-0.42	67,6	-0.3
13		1958	58	3,62	0.27	44,68	-0.55	67,4	-0.5
16		2080	180	3,58	0.23	45,86	0.63	67,4	-0.5
LSD	005	239		0,25		0,63		0,5	
	001	460		0,40		1,26		0,7	

Applying of ultra low frequencies electromagnetic field was increased rapeseed yield in our research. In reachable literature we didn't find paper works about this plant species, but similar research were done on maize, wheat, soybean, sunflowers, cucumber, sugar beet. Our results about positive effects of applied method are in accordance with results of *Malešević et al.* (2001), *Marinković et al.* (1998, 2000, 2001), *Crnobarac et al.* (2001.), *Grigorev et al.* (1998.), and *Maronek* (1975.).

Conclusions

RIES technology increased grain yield at Banacanka cultivar from 269 $kgha^{-1}$ to 457 $kgha^{-1}$. The best variants were 7 and 11; yield increasing at these variants were 407 $kgha^{-1}$ (21.8%) and 457 $kgha^{-1}$ (24.4%). At Pronto cultivar yield increased significantly at variant 13 for 408 $kgha^{-1}$ (16.9%) during at Falcon cultivar increasing was only 180 $kgha^{-1}$ (at variant 16).

In relation to control mass of 1000 grains was higher: at Banacanka cultivar mass of 1000 grains increased for 18.8% (0.59 g) at variants 11 and 16. At Pronto cultivar mass of 1000 grains increased for 2.86% (0.10g) on variant 11, and at Falcon cultivar, increasing was 0.27 g (8.06%) on variant 13.

Oil content was increased for 1.09% (variant 13) at Banacanka cultivar, 1.82% (variant 16) at Pronto cultivar and 0.63% (variant 16), at Falcon cultivar.

Test weight of all three cultivars was at control level.

Applying of ultra low frequencies for seed treatment (RIES technology) significant results ere achieved. At Falcon cultivar we should more investigate, so that we can get better results.

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