

**INFLUENCE OF STATIONARY MAGNETIC FIELD ON THE EARLY STAGES OF THE DEVELOPMENT OF TOBACCO SEEDS (*NICOTIANA TABACUM L.*)**  
**ВЛИЯНИЕ НА ПОСТОЯННО МАГНИТНО ПОЛЕ ВЪРХУ РАННИТЕ ЕТАПИ ОТ РАЗВИТИЕТО НА СЕМЕНА ОТ ТЮТЮН ( *Nicotiana tabacum L.*)**

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**РЕЗЮМЕ**

Изследвано е влиянието на постоянно магнитно поле с индукция **0,15 T** при експозиции *10 min, 20 min u 30 min*, върху семена от тютюн ( *Nicotiana tabacum L.*), сорт Харманли 11. С цел да се установи въздействието върху жизнеността на семената, са определени кълняемата енергия *GE* и кълняемостта *G*. Установено е, че магнитното поле стимулира развитието на кълна, води до повишаване на кълняемата енергия и кълняемостта. Предложена е хипотеза за обяснение на получените резултати относно стимулиращия ефект на третирането с магнитно поле.

**КЛЮЧОВИ ДУМИ:**Постоянно магнитно поле, кълняемост, кълняема енергия, тютюнл

**ABSTRACT**

The influence of a stationary magnetic field with induction of **0,15 T** at expositions *10 min, 20 min u 30 min*, on tobacco seeds (*Nicotiana tabacum L.*), cv. Harmanly 11 has been investigated.

The germination energy *GE* and the germination *G* have been determined with the aim of establishing the effect of the magnetic field on seed vitality. It has been found out that the magnetic field stimulates the development of the germ and leads to increasing the germination energy and germination. A hypothesis about the explanation of the results obtained has been proposed, especially about the stimulating effect of the magnetic field treatment.

**KEY WORDS:** Stationary magnetic field, germination, germination energy, tobacco.

### DETAILED ABSTRACT

Tobacco seeds (*Nicotiana tabacum L.*), cv. Harmanli 11, harvest 2002, have been treated by a stationary magnetic field with an induction of 0,15 T at expositions 10 min, 20 min and 30 min with and without preliminary soaking for 24 hours in distilled water.

Germination *G* and germination energy *GE* of the seeds have been determined on 4 replicates of 100 seeds per variant, in laboratory conditions, on germination beds of wet filter paper.

The mathematical processing of the results showed that the significance of the differences to the control for dry seeds and seeds preliminary soaked for 24 hours, at various level of significance (5, 1 и 0,1%) was proved for all the variants concerning both the germination energy and germination.

Experimental data show that the germination energy and the germination of tobacco seeds rised linearly with their exposition in the magnetic field. The comparison of the effect of the magnetic field treatment on preliminary soaked for 24 hour and non-soaked tobacco seeds showed that the preliminary soaking in water led to the increase of the germination energy and germination.

The regression analysis showed that a linear dependence was detected between the exposition in the magnetic field and the germination (Fig. 3), which can be described by the equations

$$G = 0,088t + 0,215.$$

and

$$G = 0,0745t + 0,3,$$

for non-soaked and preliminary soaked seeds, respectively.

These facts can be explained by the hypothesis assuming that some organelles of plant cells posses paramagnetic properties like that found in chloroplasts by Commoner et al, 1956. As a result of the interaction between the outer magnetic field and the magnetic moment of unpaired electrons supposed to exist in some organelles like mitochondria, microwave energy is absorbed (Commoner B. et all. 1954). This energy later is transformed in chemical one and accelerates the vital processes in seeds.

## INTRODUCTION

It has been established that the influence of the magnetic field on the seeds fastens their growth, activates protein formation and the root growth [3-8]. The strong, many-sided influence of the fast initial growth of the plants after the germination in different aspects is well known (Aladjadjiyan, 2002). It gives the plants the possibility of overcoming the unfavorable consequences of weeding and adequate use of sun radiation. We found in earlier investigations that the magnetic field influence on the seeds of various crops and ornamental tree species increased the germination of non-standard seeds and improved their qualities (Aladjadjiyan, 2002). The reason of this effect can be searched in the presence of paramagnetic properties in chloroplasts (Commoner, 1956), which can cause an acceleration of seeds metabolism by magnetic treatment. Having in mind the future application of the magnetic field treatment in agricultural practice we investigated its influence on the early stages of the development of tobacco seeds (*Nicotiana tabacum L.*). Its seeds they are rather small-sized, the germination usually is low, and the stimulation can contribute significantly to their faster growth – a crucial moment in tobacco production. The experiments of Commoner, 1956, carried out also on *Nicotiana tabacum L.*, were an additional reason to choose tobacco,

## MATERIAL AND METHODS

Tobacco seeds (*Nicotiana tabacum L.*), cv. Harmanli 11, harvest 2002, have been treated by a stationary magnetic field with an induction of 0,15 *T* at expositions 10 *min*, 20 *min* and 30 *min* with and without preliminary soaking for 24 hours in distilled water.

Germination *G* and germination energy *GE* of the seeds have been determined on 4 replicates of 100 seeds per variant, in laboratory conditions, on germination beds of wet filter paper. The experiment has been carried out in January - March 2003, under

controlled laboratory conditions: air temperature of 22÷24 °C and photoperiod 16: 8 *h* (photo phase: scoto-phase).

A static magnet has performed the treatment with a stationary magnetic field. The induction of the magnetic field has been measured by digital teslameter Systron – Donner, its average value being 0,15 *T*. As the magnetic field between the poles was not homogeneous enough, the samples have been fixed in a defined section of the field by stiropore packing.

With the aim of establishing the influence of the treatment on seed vitality, the main indices - germination energy *GE* and germination *G*, have been determined. Data were statistically processed using the method of Fisher of dispersion analysis (5.0%\*, 1.0%\* and 0.1%\* - GD). The average value  $\bar{x}$ , average deviation  $\sigma$ , average square error *m*, borderline differences *GD<sub>P%</sub>* at reliability *P%* have been determined, using the formulae

$$\bar{x} = \frac{\sum x}{n}$$

$$\sigma = \sqrt{\frac{(x - \bar{x})^2}{n - 1}}$$

$$m = \frac{\sigma}{\sqrt{n}}$$

$$GD_{P\%} = t_{P\%} \sigma,$$

In the last formula *t* is Student's criterion at reliability *P%*.

## RESULTS AND DISCUSSION

Germination energy *GE* of the investigated seeds has been determined on the 9<sup>th</sup>, and germination *G* – on the 16<sup>th</sup> day. Statistical data about the germination energy and the germination are presented in the tables.

Table 1: Values of germination energy and germination of non-soaked seeds, treated by a magnetic field

Variant Replication		control		10 min		20 min		30 min	
		GE%	G, %	GE%	G, %	GE%	G, %	GE%	G, %
I		23	28	33	44	35	49	42	55
II		25	25	30	45	40	46	44	51
III		21	33	32	41	36	51	40	59
IV		26	30	38	39	41	51	43	58
$\bar{X}$		23.75	29	33.25	42.25	38	49.25	42.25	55.75
$\sigma$		14,75	34	34,75	22,75	26	16,75	8,75	38,75
$m$		2,71	4,12	4,16	$3,3726$ 8	3,60	2,89	2,09	4,40
GD	5,0%	2,38	4,80	1,82	2,48	3,14	2,99	2,38	4,76
	1,0%	3,21	6,50	2,46	3,35	4,25	4,05	3,22	6,45
	0,1%	4,31	8,69	3,28	4,48	5,69	5,42	4,31	8,61

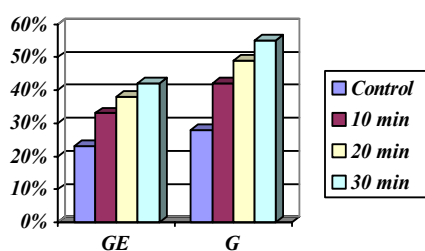
Table 2: Values of germination energy and germination of preliminary soaked seeds, treated by a magnetic field

Variant Replication		control		10 min		20 min		30 min	
		GE%	G, %	GE%	G, %	GE%	G, %	GE%	G, %
I		31	37	38	48	45	53	51	60
II		33	42	38	47	43	49	48	58
III		25	34	36	45	42	52	45	56
IV		29	34	33	41	44	52	48	64
$\bar{X}$		29,5	36,75	36,25	45,25	43,5	51,5	48	59,5
$\sigma$		4,18	4,62	2,89	3,79	1,58	2,12	3	4,18
$m$		2,40	2,33	0,67	0,88	0,88	1,20	1,73	1,15
GD	5,0%	4,95	4,80	1,37	1,81	1,82	2,47	3,57	2,38
	1,0%	6,69	6,50	1,86	2,45	2,46	3,35	4,83	3,22
	0,1%	8,95	8,69	2,48	3,28	3,28	4,47	6,45	4,31

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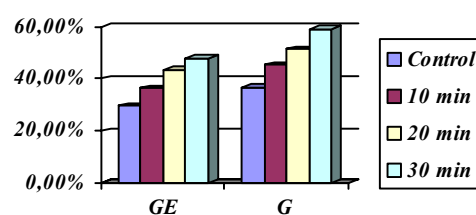
The mathematical processing of the results showed that the significance of the differences to the control for dry seeds and seeds preliminary soaked for 24 hours, at various level of significance (5, 1 и 0,1%) was proved for all the variants concerning both the germination energy and germination.

Fig.1. - Vitality indices for non-soaked tobacco seeds, treated with a stationary magnetic field.



The dependencies of germination energy and germination vs. exposition in a magnetic field have been presented in Figures 1 and 2, for non-soaked and preliminary soaked for 24-hours in distilled water, respectively

Fig.2. – Vitality indices for tobacco seeds preliminary soaked for 24 hours in distilled water, treated with a magnetic field.



Data, presented in figures 1 and 2 show that the germination energy and the germination of tobacco seeds (*Nicotiana tabacum L.*), cv. Harmanli 11, harvest 2002, rised linearly with their exposition in the magnetic field.

The comparison of the effect of the magnetic field treatment on preliminary soaked for 24 hour and non-soaked tobacco seeds showed that the preliminary soaking in water led to the increase of the germination energy and germination.

The regression analysis showed that a linear dependence was detected between the exposition in the magnetic field and the germination (Fig. 3), which can be described by the equations

$$G = 0,088t + 0,215.$$

and

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for non-soaked and preliminary soaked seeds, respectively.

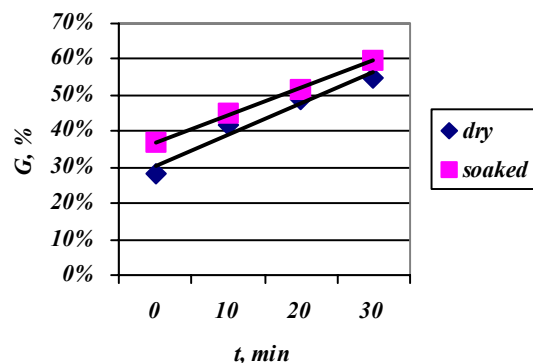


Fig.3 – comparison of the germination of tobacco seeds, treated with a magnetic field with and without preliminary soaking in distilled water.

The regression analysis showed that the dependence of the germination vs. exposition for the non-soaked seeds as well as for the preliminary soaked ones, treated with a magnetic field was almost the same. The influence of preliminary soaking was quantitative only – the germination of preliminary soaked seeds compared with non-soaked ones increased by about 10 %.

The treatment with a stationary magnetic field stimulated the germination of seeds. This fact can be explained by the hypothesis assuming that some organelles of plant cells (i.e. mitochondria) possess paramagnetic properties like that found in chloroplasts by Commoner et al, 1956. Metabolically active tissues of plant cells contain free radicals. They play an important role in electron transfer and in the kinetics of

the chemical reactions. These free radicals possess non-paired electrons with magnetic moments that can be oriented in the outer magnetic field. As a result of the interaction between the outer magnetic field and the magnetic moment of unpaired electrons microwave energy is absorbed (Commoner B. et al. 1954). This energy later is transformed in chemical one and accelerates the vital processes in seeds.

The effect of the magnetic field treatment was stronger for preliminary soaked seeds. This observation can be due to the fact, that the water molecule also possesses paramagnetic properties and absorbs the energy of the magnetic field. This energy is also transformed in chemical one and it is an additional amount to that absorbed by the free radicals, existing in plant tissues of non-soaked seeds.

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