

# THE INFLUENCE OF THE ELECTROMAGNETIC FIELD ON MITOSIS AND CATALASE ACTIVITY IN MAIZE CARYOPSES WITH DIFFERENT VIABILITIES AND AGES

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**Abstract:** Five maize caryopse samples, having various viabilities and storage periods, were subjected (as dry and imbibed seeds) to an alternating electromagnetic field of 6000 Hz, determining, in this conditions, the value of some mitosis indices and the catalase activity. At all studied samples, both the analysed mitosis indices (cells in division and polyloide cells) and the catalase activity have generally registered modifications, compared to blanks (unstimulated seeds), expressed through increase of the mentioned indices and of the enzyme activity, mainly when the electromagnetic stimulus was applied to the imbibed seeds.

## INTRODUCTION

Many cytological, biochemical and physiological researches on reduced viabilities caryopses have evidenced some specific modifications to each domain, favourising, at the same time, some methods and proceedings development to increase the viability and vigour of those caryopses.

Within the framework of physical procedures there were initiated and developed stimulation techniques using a static or an alternant electromagnetic field.

Using an alternant electromagnetic field (AEF), the aim of this paper is to investigate some effects of this physical stimulus on the mitosis and catalase activity in maize caryopses having different ages and terms of storage.

## MATERIALS AND METHODS

The researches were carried out on 5 samples of maize caryopses belonging of 5 maize landraces, stored in the Suceava Genebank, on different terms (between 1 and 17 years, under appropriate conditions of temperature and humidity (table nr.1). In these conditions, the sample P1, having the greatest germinative capacity (96%), has served as control sample.

Table 1. Features of used biological material

Caryopses Samples	Storage period (years)	Germination (%)	W.T.G (g)	Humidity(%)
P1	1	96	218	11,35
P2	10	78	220	11,40
P3	15	50	223	11,40
P4	15	65	220	11,45
P5	17	28	225	11,40

WTG = weight thousand grain; ; P1..P5 = caryopse samples.

We used 4 repetitions of maize caryopses( each of them containing 50 caryopses) and a standard device to apply the electromagnetic field (according to Alexander and Doijode, 1995).

The microscopical investigations were carried out after 72 hours of germination period on adventive roots, using the Carr method to investigate the mitosis and polyploid cells number.

The catalase activity was determined using the titrimetric method (according to Dumitru, 1967).

## RESULTS AND DISCUSSIONS

The analysis of processed data evidences the number of the mitotic cells, polyploid cells and the catalase activity in all maize caryopses samples before the electromagnetic field action (table nr.2).

Table 2. The values of some mitotic indices and of the catalase activity in unstimulated biological material

Caryopses	Samples	P1	P2	P3	P4	P5
Indices	DC (‰)	120	95	60	84	28
	PC (‰)	8	18	25	15	34
	CA	20,75	23,32	16,14	12,09	15,94

DC = dividing cells; PC = polyploid cells; CA = catalase activity; P1..P5 = caryopse samples

As one can see, the mitotic cells number and the catalase activity have registered higher values in the caryopses samples with the highest germination percentages (P1 and P2). The caryopses samples with a reduced germination capacity (P3 and P5) were registered the highest oyploidy cells number.

The electromagnetic field action on the dried and imbibed caryopses has modified some mitotic indices in relation to the control samples (blanks) (table nr.3).

Table 3. The values of some mitotic indices under the influence of AEF treatment

Indices	DC-dc (‰)		PC-dc (‰)		DC-ic (‰)		PC-ic (‰)	
Samples	Cells nr.	% beside blank*	Cells nr.	% beside blank*	Cells nr.	% beside blank*	Cells nr.	% beside blank*
P1	138	115,00	9	111,11	144	120,00	16	200,00
P2	132	138,94	36	200,00	137	144,21	50	277,77
P3	93	155,00	67	268,00	110	183,33	77	308,00
P4	109	129,76	42	280,00	121	144,05	48	320,00
P5	49	175,00	162	476,47	80	285,71	189	555,88

DC-dc = dividing cells of dried caryopses; PC-dc = polyploid cells of dried caryopses; DC-ic = dividing cells of imbibed caryopses; PC-ic = polyploid cells of imbibed caryopses; \* = blank (100%), index value without stimulation; P1..P5 = caryopse samples.

The mitotic cells number has registered the highest values (55 and 75%) in relation with blank in the lowest germination samples and the longest storage periods (P3 and P5). In high germination samples, the dividing cells number increase, beside blanks, has oscilated between 15% (P1) and 39% (P2). The sample P1 having highest germination capacity (stored under optimal conditions) has registered, as seen, the most reduced increasing of this index. As to polyplod cells number, the difference beside blanks (index value of unstimulated caryopses) has

oscilated between 11 and 376,5%, the most reduced germination sample P5 having the greatest value.

The greatest polyploidy cells number, as a result of the electromagnetic field action on old or/and low germination caryopses could be ascertain to division mechanism damage or cytokinesis inhibition, more frequent processes in aged cells.

Subjecting imbibed caryopses (ic) to electromagnetic field action, on can see that the both investigated indices have registered higher values beside dried caryopses. Thus, the dividing cells number (DC-ic) has had increases (beside blanks) between 20 and 185,7% and the polyploidy cells (PC-ic) between 100 and 455,9% - in this case the highest values being in reduced germination and long storage period samples as well.

The table nr.4 reproduces the maize caryopse catalase activity values, subjected (dried or imbibed) to electromagnetic field action. If on stimulated dried caryopses the catalase activity has registered a moderate increase (8,2 and 14% beside blanks) in two cases, in imbibed stimulated caryopses the activity of this enzyme has enhanced in 4 samples with values between 17 and 40%.

Table 4. Maize caryopse catalase activity values under the influence of AEF treatment

CS	P1		P2		P3		P4		P5	
SM	CA	% beside blank*	CA	% beside blank*	CA	% beside blank*	CA	% beside blank*	CA	% beside blank*
dc	22,45	108,19	21,57	92,49	15,05	93,25	13,78	113,98	15,07	94,54
ic	25,01	120,53	23,05	98,84	21,47	133,02	16,90	139,78	18,64	116,94

CS = caryopses samples; SM = stimulated material; CA = catalase activity; dc = dried caryopses; ic = imbibed caryopses; P1..P5 = caryopse samples.

The modification of the investigated mitotic indices and of the catalase activity under influence of alternating electromagnetic field, leads us to the idea of involving of physical stimulus on complex biochemical and physiological mechanisms and not only the elimination of inhibitions caused by tegument impermeability, deficiency in water, nutrients uptake a.s.o.

## CONCLUSIONS

The mitotic division in the adventive roots meristem tips, belonging of 5 maize caryopses samples with different viabilities ages and germinative capacity, was modified under alternative electromagnetic field action with 6000 Hz frequency. The older maize caryopses samples with a low level of germination have registered the highest number of dividing and polyploid cells.

The influence of the alternative electromagnetic field manifested on the catalase activity, increasing the activity of the enzyme.

The electromagnetic signal increased the level of the mitotic indexes and the catalase activity too in the imbibed caryopses samples.

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