CHANGES IN GROWTH REACTIONS OF ENCRUSTED MAIZE SEEDS DURING STORAGE

MODIFICĂRI ÎN REACȚIILE DE CREȘTERE ALE SEMINȚELOR ÎNCRUSTATE DE PORUMB ÎN TIMPUL DEPOZITĂRII

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The purpose of the research was to study the effect of storage time on biometric parameters during the germination of encrusted seeds. A differential effect of seed encrustation on germination, growth of roots and seedlings depending on the hybrid was revealed. After 12 months of storage, the encrusted seeds showed an increase in overall germination by 2.0-5.5% compared to intact seeds. It has been established that pre-sowing encrustation of maize seeds with a bioconjugate containing the genistifoliosides, biologically active substances of natural origin, and a film-forming agent (sodium salt of carboxymethylcellulose) helps to preserve the sowing qualities of seeds during long-term storage and improves the biometric parameters of germinated seeds.

***Keywords**: carboxymethyl cellulose, encrustation, genistifoliosides, maize seeds*

Scopul cercetării a fost de a studia efectul timpului de păstrare asupra parametrilor biometrici ai semințelor încrustate la germinarea lor. S-a evidențiat un efect diferențial al încrustării semințelor asupra germinării, creșterii rădăcinilor și plantulelor în funcție de hibrid. După 12 luni de depozitare, semințele încrustate au prezentat o creștere a facultății germinative cu 2,0-5,5% comparativ cu semințele intacte. S-a stabilit că încrustarea înainte de semănat a semințelor de porumb cu un bioconjugat care conține genistifoliozide, substanțe biologic active de origine naturală și un agent filmogen (sarea de sodiu a carboximetilcelulozei) protejează păstrarea calităților de semănat ale semințelor pe termen lung de depozitare și îmbunătățește parametrii biometrici ai semințelor germinate.

***Cuvinte-cheie:** carboximetilceluloza, încrustație, genistifoliozide, semințe de porumb*

INTRODUCTION

The yield of maize is directly related to the quality of seeds, which affects the resistance of the plant to diseases, pests, non-optimal temperatures and drought. Seeds with high varietal and sowing qualities can increase the seed yield by more than 30% [1, 2]. These problems can be solved by breeding, seed production and technology of cultivation.

Seed encrustation is of particular interest for solving these problems. Encrustation consists in spraying or immersing seeds in solutions or suspensions of polymers. In contrast to dry and wet dressings, when encrusting, a uniform layer is formed, fixed on the surface of the seed, in the form of a second shell. The composition of this layer includes optimal doses of the active substance, which are distributed without gaps over the surface of the seeds, firmly adhere to the seeds, which eliminates their loss during packaging, transportation and sowing. Strict environmental requirements for the use of chemicals in agriculture, high prices for pesticides and seed material have led to the use of different methods of pre-sowing treatment of crop seeds. The widespread use of plant growth bioregulators of natural origin in recent years is primarily due to their high economic efficiency. It has been proven that due to small doses of growth regulators, the cost of seed treatment when they are included in the composition of complex seed disinfectants is minimal. The return on investment by increasing the yield is high [3].

In general, all known natural biologically active substances at the initial stage of plant development give positive results: they increase the energy of growth and seed germination, the shoots and root system increase significantly in size [4, 5]. Many of them have fungicidal properties [6, 7]. Seed quality can be seen as a standard of excellence for certain characteristics or traits that determine the performance of seeds in planting or storage [8]. Therefore, the purpose of our research was not only to study the possibility of combining preparations for pre-sowing encrustation and their dosage when incrusting maize seeds, but also the effect of the storage time of treated seeds on their biometric parameters during germination.

MATERIAL AND METHOD

The sodium salt of carboxymethyl cellulose (CMC) was used as a film former, which, due to its ability to form viscous solutions, is used in the chemical, food and medical industries as a plasticizer, thickener and resorbent. Biologically active substances - genistifoliosides (the sum of iridoid glycosides from the aerial part of the plant (*Linaria genistifolia* (L.) Mill) were used as the growth regulator in these studies. The seed of maize hybrids of the Institute of Crop Science "Porumbeni", which have different maturation periods and varying degrees of resistance, were tested. The maize hybrid Porumbeni 427 (P427), FAO 420 is a mid-late ripening medium drought-resistant hybrid with a potential grain yield of 12-14 t/ha, and the hybrid Porumbeni 458 (P458), FAO 450 is late-ripening, the grain yield reaches to 13-15 t/ha, is drought tolerant.

In the studies, an encrusting complex was used - genistifolioside 0,1% and CMC 1,0% (GL+CMC), which was released earlier according to positive results in our studies

on vegetable seeds, in which various concentrations of the complex components were used [9]. In the experiments, maize seeds were treated not only with the encrusting complex, but also separately with a solution of genistifolioside, which is part of this complex. In addition, for comparison, seeds industrially encrusted with fungicidal solutions (II) at maize processing plants were also used in the experiment. Due to the fact that seed encrustation can be carried out both immediately before sowing and in advance, some of the treated seeds were stored during 4 and 12 months. Encrusted seeds were germinated in Petri dishes before and after storage according to the generally accepted method [10]. After 7 days of germination, the parameters of laboratory germination were determined, biometric measurements were taken (the length of roots and seedlings). Untreated (intact) seeds served as control. The experiments were carried out in 4-fold repetition.

RESULTS AND DISCUSSION

As a material for multiplication, seeds are characterized by sowing qualities, a set of properties that determine the degree of their suitability for sowing and storage.

Seeds of maize hybrids had a high initial laboratory germination: P427 – 96.0% and P458 – 98.0%. When applying seed treatment with a solution of genistifoliosides before storage, a decrease in germination by 4.1-9.4% was observed in comparison with control options. Encrustation of seeds with the complex also reduced this parameter before storage, but slightly (by 4.0%). However, industrial pre-sowing treatment caused a decrease in germination in the seeds of P458 hybrid by 10.2% relative to the control and had no negative effect in the hybrid P427.

An analysis of the data on the germination of maize seeds in experiments before and after storage (4 and 12 months) showed that the overall germination of encrusted seeds responds to the duration of storage, depending on the hybrid (fig. 1).

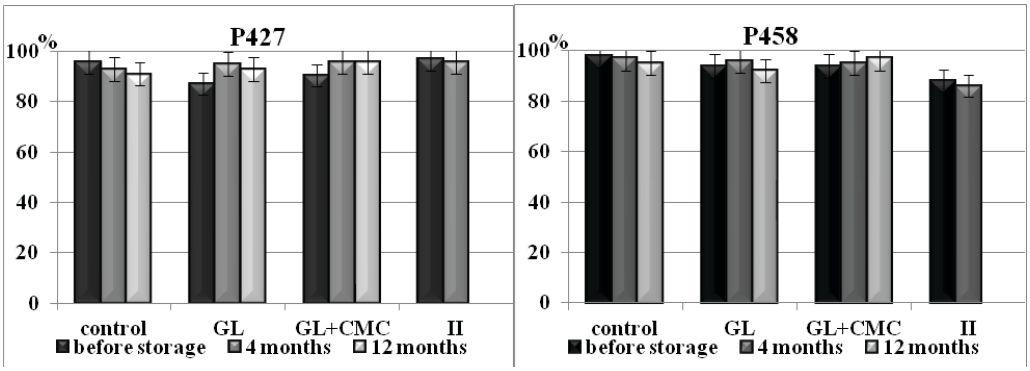


Figure 1. Effect of storage on overall germination capacity of encrusted maize seeds

It is noteworthy that after 4 months of storage, the germination of seeds of the hybrid maize P427 coated with the encrusting complex increased by 3.2% compared to un-

treated seeds, and after 12 months - by 5.5%. In hybrid P458, these indices ranged from -2.1% to +2.1%, respectively. However, if storage for 4 months of P427 hybrid seeds with the use of industrial encrustation had almost no effect on laboratory germination, then for P458 maize seeds it decreased by 11% compared with control indicators

The storage time of experimental samples of seeds, depending on the hybrid, had a differential effect on the growth of rudimentary roots and seedlings. After 12 months of storage, the seeds of the P427 hybrid showed an increase in the length of seedlings in experiments using treatment with the GL+CMC complex by 16% compared with control seeds, and the P458 hybrid - by 1.8% (tab. 1).

Table 1

Effect of storage on seedling growth of encrusted maize seeds

Variant		P427				P458			
		cm	**min**	**max**	**± of control, %**	**cm**	**min**	**max**	**± of control, %**
Before storage	control	4.45±1.3	1.0	10.2		5.65±2.0	1.0	11.2	
	GL	6.61±1.9	1.0	10.8	46,9	4.83±1.8	1.0	10.5	-14.5
	GL+CMC	3.95±1.0	1.0	6.5	-11,2	4.57±1.5	1.0	8.5	-19.1
	II	3.86±0.9	1.8	6.0	-13,3	5.37±2.0	0.5	11.5	
4 months storage	control	4.30±1.3	1.0	8.2		6.7±1.9	2.0	11.8	
	GL	2.70±1.2	0.8	6.4	-37,21	5.6±1.7	1.0	10.8	-16.42
	GL+CMC	5.00±1.3	2.0	9,5	16,28	7.0±1.6	3.0	11.5	4.8
	II	5.70±1.4	2.0	9,0	32,56	5.8±1.8	1.0	10.2	-13.43
12 months storage	control	4.60±1.5	1.0	10.5		6.64±2.0	1.5	12.0	
	GL	4.90±1.5	2.0	10.0	17,79	6.2±1.8	1.0	11.5	-6.63
	GL+CMC	4.84±1.6	1.0	10.5	16,35	6.76±2.1	1.0	12.5	1.8

As you know, the germination of the seed of most plants begins with the growth of the root. At this stage of ontogeny, at the moment of plant transition from heterotrophic to autotrophic nutrition, it is the germinal root that is the main regulatory organ that determines the activity of the plant [11]. In experiments, a positive responsiveness of the length of germinal roots in the studied hybrids to seed storage was noted, in contrast to seedlings (tab. 2).

Table 2

Effect of storage on root growth of encrusted maize seeds

Variant		P427				P458			
		cm	min	max	± of control, %	см	min	max	± of control, %
Before storage	control	8.11±2.2	2.0	20.2		8.82±2.7	3.0	19.0	
	GL	12.15±3.7	4.5	19.7	49.8	9.49±1.8	1.0	16.2	7.6
	GL+CMC	8.28±1.9	3.0	14.0	2.1	9.00±2.5	2.5	17.0	2.0
	II	8.45±2.1	3.2	15.0	4.2	9.63±3.9	1.0	23.0	9.2
4 months storage	control	7.23±2.2	1.0	16.0		11.70±3.4	2.0	19.8	
	GL	8.1±2.4	1.5	15.5	12.0	9.50±3.3	2.0	16.7	-18.80
	GL+CMC	8.4±1.9	4.5	15.8	16.2	11.12±3.0	5.0	17.6	-4.9
	II	11.76±3.0	5.5	21.5	62.6	8.50±3.3	1.0	19.0	-27.35
12 months storage	control	7.88±2.6	0.5	13.7		8.71±2.4	2.0	16.0	
	GL	8.92±2.7	3.0	16.7	13.2	8.59±2.3	1.0	16.6	-1.38
	GL+CMC	8.28±2.9	2.9	16.2	5.08	8.92±2.9	1.0	18.4	2.41

In the P427 hybrid, the root length after seed storage for 4 months was higher than the control variants by 15% (GL), 20% (GL+CMC) and 62.6% (II).

In the P458 seed with the same time of storage in the variant with the use of industrial encrustation, the roots were 3 cm shorter than the control plants (tab. 2). It is noteworthy that in all experiments, the storage of seeds for 12 months did not lead to a significant change in the length of the roots in comparison with the parameters of the experiments before storage, i.e. sowing quality of seeds was not affected by long-term storage.

CONCLUSIONS

It was revealed that the duration of storage of encrusted seeds had a differential effect on the germination and growth of roots and seedlings, depending on the hybrid. Storage for 12 months of seeds encrusted with GL+CMC contributed to an increase in overall germination by 2.0-5.5% relative to the control. The obtained results of experimental studies give grounds to assert that pre-sowing encrustation of maize seed material with a complex mixture of biologically active substances of natural origin (genistifoliosides) and a film-forming agent (sodium salt of carboxymethylcellulose) helps to preserve the sowing qualities of seeds during long-term storage and improves their biometric parameters during germination.

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