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COMPARATIVE STUDY OF THE DECLINE OF VIABILITY OF MAIZE INBRED LINES AND HYBRID MAIZE (*Zea mays* L.) SEEDS, AFFECTED BY THE AGING PROCESS AND STORAGE CONDITIONS

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Abstract

As with any living organism, reproduction, aging and then death is a complex phenomenon unfolding within the seed, in which there is not only her life, but also hereditary properties of the plant that are of particular importance in the production potential. The seeds belonging to four inbred lines and five maize hybrids were stored in a dry state, in an open warehouse for a period of 36 months, and their germination, was evaluated in the initial phase, and then after every 12 months. The object of this research is the Study of the aging process (the decline of viability) of the "orthodox" seeds stored and develop a complex equation for seed viability, to make it possible to predict the germination of the lots, after a period of storage. For seed lots where the average germination has to be higher than the minimum allowed value we will introduce the concept "useful life" of the lot. Using the procedure of orthogonal polynomial coefficients the sum of squares SS_{Δ} of the factor duration of storage and SS_{LxD} of the interaction Lines x Duration storage, they were broken down into components: Δ_L–Linear, Δ_Q– Quadratic and Δ_{rez}-Residual meaning L x Δ_L - Linear, L x Δ_Q - Quadratic and L x Δ_{rez} - Residual. The significant effect of the component, Linear and Square in the case of both factors, shows that the reactions of the lines regarding the preservation of the quality during the storage under the given conditions are unpredictable, which means that the answer cannot be predicted and quantified according to a certain equation. For the hybrid seed of maize belonging to the studied lots, an equation of the viability of the seeds of the form could be developed: $v=K_i - tg\ \varphi\ *p$, whose slope coefficient $d=tg\varphi$ is assimilated with the rate of deterioration of seed lots. In addition to controlling and adjusting the parameters of the storage environment, fungicide treatment has proven to be a solution, in increasing the "useful life" of the lot. By treating the seeds of the Turda Favorit hybrid with the fungicide, the rate of decline decreases more than double, from $d=4.5x10^{-4}$ (untreated variant), to $d=2.0x10^{-4}$. In the case of the inbred lines, a weaker preservation of the initial seminal qualities is observed than in the case of the hybrid maize seed. Conservation capacity depends on the genetic particularities of each genotype or line.

Key words*: maize hybrid seed, seed viability, inbred lines, storage conditions*.

INTRODUCTION

The seed, destined for sowing, biological factor, life-bearing and genetic heritage, both attributes in interaction with a permanently changing environment throughout the life of the ***seed-plant-again seed*****,** is an important factor of production, the first step in climate change mitigation measures. The special importance of maize is due not only to the high production potential but also to the many uses of the grains: in human nutrition, animal feed and bioethanol production. After 1960, with the creation and introduction into culture of the first maize hybrids obtained on the basis of inbred lines and the exploitation of the heterozis phenomenon, a doubling of the production is made compared to the one previously obtained from the local varieties and populations (Cristea, 2004).

The quantity and quality of the agricultural production reflects the biological properties of the seeds used, the environment, the applied culture technology, the harvesting processing and, last but not least, ***the management of the preservation*** (Duda and Moldovan, 2008).

Keeping the seeds for sowing is a complex of measures that must be applied in order to maintain the quality of the seed for a longer period of time. For this it is necessary to know the requirements of the species in relation to the parameters of the storage environment (*temperature, relative humidity, air composition, equilibrium humidity, destructive attack of microorganisms and insects*) in order to minimize the physical, chemical and biochemical processes during storage. In order to limit the action of these factors on the normal process of seed aging, with consequences on the semen quality, it is necessary to know, control and regulate this process, in order to extend the ***"useful lifetime"*** of the seed lots. The duration of the seed life, usually expressed in years or days, is called in the literature, *longevity*. In practice we work with seed lots, so with populations, we will have to talk about a different longevity, which means the time frame in which the seeds in the lot still have an average germination higher than a minimum allowed value (*Law 266/2002). The fact that there are no immortal organisms there was introduced the concept, the ***'useful life'*** of the lot and constitutes the main variable of a system in which a set of phenomena and physical-mechanical, physiological interconnected processes are identified, and all interacting with a continue changing environment (Bărbos and Moldovan, 2016). The distribution of cumulative frequencies of seed death of a lot (seed populations) is, according to Ellis and Roberts (1980), Gaussian of the form:

$$y= \{1/\sigma \sqrt{2\pi}\} \exp\{-(p-\mu)^2/2\sigma^2\} \qquad (1)$$

where: **p**- period of time
y - relative frequencies
σ - standard deviation
μ - average survival period.

The aging of the seeds is the result of the diminution of the enzymatic capacity (Ching, 1972) and of the total content of soluble proteins (Murariu et al., 1998), consequently the depreciation of the proteins determines the appearance of deteriorating reactions. To maintain seed viability at a high level during storage, it is mandatory to select for storage, seeds that have high levels of viability before storage (Modi, 2004). The most used storage method in the world, and with great applicability for all the seeds used as biological material, is the dry storage in "open space"-warehouse. These storage systems do not require special cooling installations, which would be expensive, but adequate constructions of concrete, such as silo or wall storage, insulated as best as possible to the outside temperature variations, provided with ventilation and control installations in different points of the parameters in the seed mass. The variant of the untreated preservation of the seeds belonging to the maize hybrids and in general of all the cereals is the most practiced, due to considerations regarding a new destination of the seeds.

Germination is an indicator of viability defined as the property of the seed to germinate under optimal conditions (Badwin et al., 2006). He predicts sunrise in the field only if the soil and conditions are near ideal (Duurant and Gummerson, 1990). Different tests of vigor should be used to obtain accurate information about the quality of a seed lot (Milosovic and Cirovic, 1994).

MATERIALS AND METHODS

A laboratory experiment began at Agricultural Research and Development Station Turda, Romania, and National İnspection for Quality of Seeds, Cluj-Napoca, Romania. Storage (open space), thermally insulated, providing small variations of environmental parameters in space at the major changes of the outside, with a temperature variation at the major changes of the outside, with a temperature variation during the year, 8-28°C and relative variation, 25-75% humidity with the possibility of applying natural aeration.

The storage conditions are referred to as treatment with subsequent graduations: an "open space" (warehouse) where untreated seed is stored; "open space" (warehouse) with seed treated with *fungicide.*

The genetic material for the study of the aging process

İnbred lines: they are parental forms used in the production of hybrids. The following lines were studied: Line LC 223 NrfT; Line LC 223 NrfC; Line LC 363; Line LC 763.

Corn genotypes have a different FAO group and come from homogeneous maize lots in terms of physical qualities (size), with initial humidity of approx. 12% and good health: *Turda 200*; *Turda 165*; *Turda 201*; *Turda Star*; *Turda Favorit*.

Storage duration with graduations: "*before sowing-2015*" is the initial moment of researches; *after 12 months*; *after 24 months*; *after 36 months*.

The experimental design: Completely Randomizat Design ***(RCD)***.

2 x 5 x 4 - four repetitions for the study of viability maize seeds.

4 x 4 - four repetitions for the study of viability İnbred lines.

Statistical Analysis The methods and techniques used in the studies conducted in this paper are given below in order of their use during the research:

- *ANOVA* for Analysis and Highlithing of factors influence by other statistic methods,
- Procedures the orthogonal polynomial coefficients (Gomez and Gomez, 1984).

RESULTS AND DISCUSSIONS

1. Study of the viability of maize hybrid seed

The process of aging of the seeds from the lots of five maize hybrids, with different FAO groups, was studied during the 36-month storage period, stored in a dry state in an "open space" -warehouse.

The influence of the factor's *duration of storage, genotype and treatment* on the viability of the seed, is appreciated, by the indicator, the standard germination (***SR 1634/1999).

The combinatorial picture of the factors, with their levels and the results of the trifactorial experiment, regarding the studied characteristic: the standard germination, an indicator of viability, are presented in Table 1.

Table 1. Combination of studied factors and results in the standard germination in the experiment on hybrid seeds maize

THE COMBINED TABLE OF FACTORS (germination, % - average values)					
TRATA-MENT (A)	GENOTYPE (B)	DURATION OF STORAGE (C)			
		"initially"	after "12 months"	after "24 months"	after "36 months"
untreated (a1)	TURDA 200 (b1)	$a_1b_1c_1$ = 98.00	$a_1b_1c_2$ = 96.75	$a_1b_1c_3$ = 96.00	$a_1b_1c_4$ = 96.00
	TURDA 165 (b2)	$a_1b_2c_1$ = 92.00	$a_1b_2c_2$= 93.00	$a_1b_2c_3$ = 86.50	$a_1b_2c_4$ = 78.00
	TURDA 201 (b3)	$a_1b_3c_1$= 96.00	$a_1b_3c_2$=96.00	$a_1b_3c_3$ = 92.50	$a_1b_3c_4$ = 89.00
	TURDA STAR b4)	$a_1b_4c_1$= 97.00	$a_1b_4c_2$ = 96.00	$a_1b_4c_3$ = 94.00	$a_1b_4c_4$ = 90.75
	FAVORIT (b5)	$a_1b_5c_1$= 95.50	$a_1b_5c_2$ = 92.75	$a_1b_5c_3$ = 90.00	$a_1b_5c_4$ = 88.50
fungicide (a2)	TURDA 200 (b1)	$a_2b_1c_1$= 97.00	$a_3b_1c_2$ = 95.75	$a_3b_1c_3$ = 96.00	$a_3b_1c_4$ = 94.75
	TURDA 165 (b2)	$a_2b_2c_1$= 93.50	$a_3b_2c_2$ = 94.00	$a_3b_2c_3$ = 89.75	$a_3b_2c_4$ = 84.00
	TURDA 201 (b3)	$a_2b_3c_1$= 96.50	$a_3b_3c_2$ = 96.00	$a_3b_3c_3$ = 94.50	$a_3b_3c_4$ = 92.50
	TURDASTAR b4)	$a_2b_4c_1$= 97.00	$a_3b_4c_2$ = 97.00	$a_3b_4c_3$= 94,.75	$a_3b_4c_4$ = 93.00
	FAVORIT (b5)	$a_2b_5c_1$= 95.00	$a_3b_5c_2$ = 95.00	$a_3b_5c_3$ = 93.25	$a_3b_5c_4$ = 92.75

$LSD_{5\%}$ =1.64; $LSD_{1\%}$ = 2.16; $LSD_{0.1\%}$= 2.80

Using the criterion F, hypothesis zero (H_0), the significant influence of the main factors considered in the study was appreciated: significant influence of the main factors considered in the study was appreciated: *seed treatment, hybrid, preservation duration and interactions of these factors, on the studied characteristic - germination.* Analyzing the results from Table 1, it is found that with the passage of time, as a result of the degradation of the enzymatic system, of the substance consumption, the decrease of the germinative capacity of the seeds is accentuated. By the bifactorial study, regarding the action of the genotype factors and the duration of the preservation on the germination of the untreated seeds belonging to the lots of the analyzed hybrids, we find their very significant influence as well as the interaction (Table 2). In this experimental variant, the normal process of aging of the seed is studied, in which case the physiological parameters are inscribed in values that ensure the ***homeostasis of the organism***. He complex character, the quality of the seeds, appreciated in this analysis only after the viability component, expressed by the standard germination, classifies the hybrids analyzed from the beginning as having "different initial seminal qualities".

Table 2. Analysis of variation for the factors action, hybrid and storage duration (non-treated)

SOURCE OF VARIABILITY	SUM OF SQUARES (SS)	DEGREE OF FREEDOM (df)	MEAN SQUARE (S^2)	COMPUTED "F"
Replication	0.7375	3	0.2458	-
HIBRID	782.925	4	195.7313	178.4729^{xxx}
DURATION OF STORAGE	633.1375	3	221.0458	201.5554^{xxx}
INTERACTION: DURAT. X HIBRID	266.175	12	22.1813	20.2255^{xxx}
ERROR	62.5125	57	1.0967	-
TOTAL	1775.4875	79	-	-

$LSD_{5\%}$ = 1.48; $LSD_{1\%}$ = 1.97; $LSD_{0.1\%}$ = 2.56

The treatment of the seeds, the practice of the performing agriculture, is obligatory, in the context in which an increasing presence of the diseases is observed, the pathogens located both on the seed and in the soil. Significant action of seed treatment on germination during storage is highlighted by analyzing, the Turda Favorit hybrid. The value of the initial germination in the variants: untreated and "treated with fungicide" is almost equal (G=95%) but, in the end after "36 months" in the "fungicide-treated" variant, it had an improved germination, G = 92.75% for G = 88.5%. The very large fluctuation of the germinations recorded by: genotype, treatment and the storage duration factor is very well evidenced by the histogram representation of the average values of each experimental variant (Figure 1). The very low values of seed germination, recorded in the "after 36 months" stage, in the case of hybrids, show the different ability to conserve the traits that define them as biological material, and that this is a genetic characteristic of each hybrid, being influenced differently by the storage conditions. By knowing, controlling and adjusting the parameters that characterize the storage environment, one can influence the aging process of the seeds, in the sense of increasing the longevity of the seed lot, respectively of its useful life, with economic consequence.

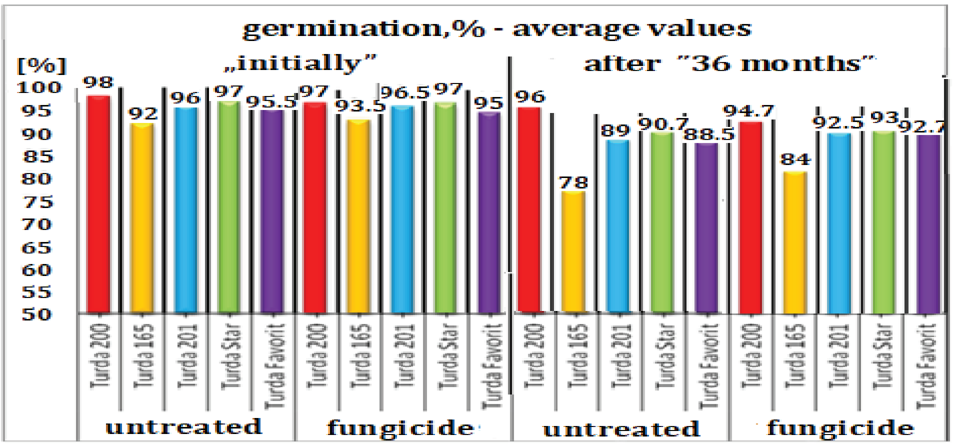

Figure 1. Variability of the distribution of results in the standard germination analys is in the experiment on hybrid seeds maize

Graphic expression of the deterioration process of seeds belonging to the lots of studied hybrids.

In order to better emphasize the decline of the viability of the studied hybrids and a more accurate appreciation of their seminal qualities after a certain duration of storage, we will use the graphical method. On the axis of the ordinates, it is represented on the left side the germination transformed, in scores, and on the right it was expressed in percentages (%), and on the axis of the abscissa is represented the duration (p), in days, of the seeds stored in "open space". Seed decline was studied for two maize hybrids, Turda 200 and Turda Favorit hybrid the newest hybrid created (Figure 2).

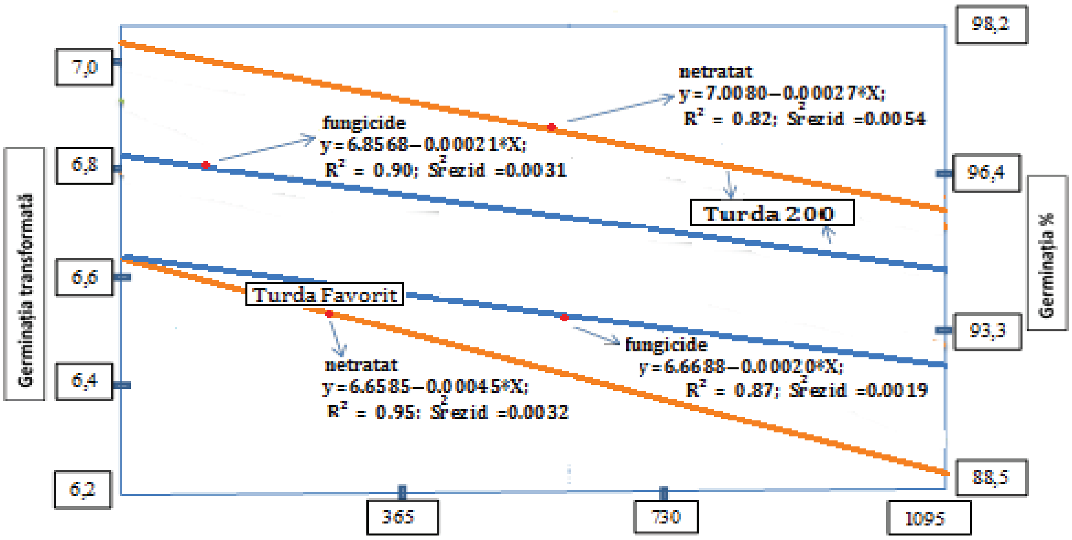

Figure 2. The rate of deterioration of untreated and treated with fungicid seed lots from the studied hybrids, stored in "open space"

The regression slope has been assimilated (germination versus storage duration) with ***the deterioration rate*** (the slope of the fall of germination), elaborating for each hybrid a mathematical model called the ***equation of the seed's viability***, of the form:

$$\mathbf{v = K_i - tg\ \varphi * p} \qquad \mathbf{(2)}$$

where: **v** - is the seed viability in probit; **K_i** - is the probit of the percentage viability at the beginning of the storage period; **φ** - the angle of the straight line (^{0}); **p** - storage duration (days); **d** = tg**φ** (the coefficient of the slope of the straight line), is the seed *deterioration rate.*

From the graph shown in Figure 2, we can see a phenomenon that is difficult to highlight by other procedures. In the case of the seed belonging to the Turda 200 hybrid, the rate of germination decline is very low, from value d = 2.7 x 10^{-4} in case of storage of untreated seed to d = 2.1 x 10^{-4} in the treated version. In contrast, in the case of the Turda Favorit hybrid, by treating the seeds with a fungicide, the decline rate decreases more than double, from d = 4.5 x 10^{-4} decreases to d = 2. x 10^{-4}. By developing a complex equation of seed viability, it is possible to ***predict*** the germinations of the seed lots, at any given time, after a period of storage, useful information for those in the seed industry, avoiding the declassification of the batches (lots), as a result of the germination drop below the allowed limit, working with economic and security working with economic and security consequences of production.

2. *The study of the viability of the maize inbred lines storage in an "open space" (warehouse)*

Considering the importance of the inbred lines in the practice of breeding, in order to produce the commercial hybrid seed with a series of traits as: adaptability, disease resistance and fall, highproduction potential, four inbred lines were taken for analysis. The inbred lines used in the creation of plant hybrids are characterized by a hereditary trait called ***combinatorial ability***, their ability to cross-breed, hybrids with high production capacity that show a strong heterozis. Due to the complexity of producing the inbred lines and the fact that in the case of maize, a high level of stability and uniformity is reached after several generations of repeated self-pollination (7-9 years) when most places become homozygous. in practice, they are produced in quantities that ***satisfy the need for several years***. In the present study, the four inbred lines were stored in the dry state and not treated, in the "open space" (warehouse). It was considered as an initial moment, the stage "before sowing 2015". The mean values of the standard germination in the four analysis stages are given in Table 3. The experimental results show a large variation of the recorded germination, both in the case of a line with the duration of storage, but also between them, in each analyse stage.

Table 3. The combined table of factors (germination % - average values)

INBRED LINES (A)	DURATION OF STORAGE (B)			
	“initially”	after “12 months”	after “24 months”	after “36 months”
LC 223 Nrf. T	a_1b_1 = 93.25	a_1b_2 = 94.00	a_1b_3 = 88.00	a_1b_4 = 87.25
LC 763	a_2b_1 = 91.50	a_2b_2 = 86.00	a_2b_3 = 80.75	a_2b_4 = 63.00
LC 363	a_3b_1 = 94.00	a_3b_2 = 92.50	a_3b_3 = 64.50	a_3b_4 = 33.00
LC 223 Nrf.C	a_4b_1 = 92.50	a_4b_2 = 85.00	a_4b_3 = 78.50	a_4b_4 = 80.00

This shows their increased sensitivity to the duration of storage and the storage conditions. For the study of the influence of the factors: A-inbred lines; B-the duration of preservation on viability, approached another analysis scheme that is based on the calculation of the so-called "deviations" $\delta_{i,}$ of individual values versus partial averages $\bar{x}_i$ and the general average $\bar{\bar{x}}$, not on the average square deviations (Table 4).

Table 4. Highlighting the influence of factors by other statistical methods

SOURCE OF VARIABILITY	DEVIATION OF THE AVERAGES OF THE PARTIAL [δ_i]	DEGREE OF FREEDOM [df]	DEVIATION OF THE MEAN [δ_i]	COMPUTED “F”
Replication (δ_R)	$\delta_R=(\sum\bar{x}^2_{Ri})/r-\bar{\bar{x}}^2= 0,219$	3		
INBRED LINES (δ_L)	$\delta_L=(\sum\bar{x}^2_{Li})/e-\bar{\bar{x}}^2 = 50,355$	3	16.785	346.79^{xxx}
DURATION OF STORAGE (δ_Δ)	$\delta_\Delta=(\sum\bar{x}^2_{\Delta i})/d-\bar{\bar{x}}^2= 112,255$	3	37.418	773.09^{xxx}
FACTORIAL VARIABILITY ($\delta_{L\Delta}$)	$\delta_{L\Delta}=(\sum\bar{x}^2_{(L\Delta)i})/l*d-\bar{\bar{x}}^2= 243.541$	15	-	-
INTERACTION,: L X Δ ($\delta_{LX\Delta}$)	$\delta_{LX\Delta} = \delta_{L\Delta} - \delta_L - \delta_\Delta = 80.931$	9	8.992	185.78^{xxx}
POOLED ERROR (δ_E)	$\delta_{E=}\ \delta - \delta_R -\delta_{L\Delta} = 2.176$	45	0.0484	-
TOTAL (δ)	$\delta = (\sum x_i^2)/N - \bar{\bar{x}}^2 =245.936$	63		

$LSD_{5\%}$ = 2.50; $LSD_{1\%}$ = 3.35; $LSD_{0.1\%}$ = 4.38

The results show that, following the application of the "F" criterion, the very significant influence on the viability of the factors: inbred lines, the duration of their preservation and their interaction. In Table 5, it presents the significance of the differences from the witness chosen within each factor.

Table 5. The separate influence of inbred lines and storage duration on germination

INBRED LINES	DURATION OF STORAGE average germination (%)				Average germination (%)	Average germination relative (%)	Difference	Computed “F”
	“initially”	after “12 months”	after “24 months”	After “36 months”				
LC 223 NrfT	93.25	94.00	88.00	87.25	90.625	127.64	20.62	**
LC 763	91.50	86.00	80.75	63.00	80.313	113.11	9.31	***
LC 363	94.00	92.50	64.50	33.00	71.00	100	-	Wit.
LC 223 NrfC	92.50	85.0	78.50	80.00	84.00	118.30	13.00	*
average germination (%)	92.81	89.37	77.93	65.81	$LSD_{5\%}$= 1.31; $LSD_{1\%}$= 1.75; $LSD_{0.1\%}$= 2.28			
average relative germination (%)	100	96.29	83.97	70.90				
difference	-	3.43	14.87	- 27				
computed “F”	Wit.	ooo	ooo	ooo				

$LSD_{5\%}$=1.26; $LSD_{1\%}$=1.69; $LSD_{0.1\%}$=2.20

For comparisons between the simple or cumulative levels of the factors the relation (3) is used:

$$F_c = \frac{n_1 * n_2}{n_1 + n_2} * \frac{(\bar{m}_1 + \bar{m}_2)^2}{s_E^2} > F_t\,(df_1=1; df_2=df_E) \qquad (3)$$

where:

$\bar{m}_1, \bar{m}_2$ – partial or cumulative averages compared; n_1, n_2-number of observations;

It is calculated: Error variance:

$$S_E^2 = \frac{N * \delta_E}{df_E} = \frac{64 * 2.176}{45} = 3.095; \qquad (4)$$

δ_i- deviation of individual values

For example: we compare Level 2 with Level 4 by the factor "Consanguinized Lines", the result:

$$F_c = \frac{16*16}{16+16} * \frac{(80.313-84)^2}{3.095} = 35.1 > F_{tabel} = 4.05;$$

which means that between the action of level 2 and level 4 of the factor "inbred lines" there are significant differences.

We note the good preservation of the viability in the case of line LC 223 Nrf.T throughout the retention period but on the contrary, we registered an accelerated deterioration of the seminal quality of the line LC363.

Significance and nature of the effects of factors on germination using orthogonal polynomial coefficients

The problem is posed to develop a complex equation of the viability of the seeds of the inbred lines that will make it possible ***to predict*** the germination of the lots at any given time, after a period of storage.

The question arises as to the nature of the effects that exist between the "standard germination" of the inbred lines and the factor "duration of storage". In order to divide a sum of the squares of the deviations of a factor that has ***(P-1)*** degrees of freedom, in sums related to the linear component, respectively quadratic, the orthogonal polynomial coefficients are used. After calculating these components, it is possible to determine the nature of the effects that exist between the "standard germination" of the inbred lines and the factor "duration of storage". The linear component within the "Sum of Squares" factor, the duration of preservation is much larger than the nonlinear part, but within the interaction the duration of preservation x inbred lines this difference is reduced to about 5 times (4217.96/831.422) (Table 6).

Due to the fact that both the linear and non-linear components are significant, in the case of the action of the factors, it shows that ***both components are of practical importance*** in describing the behavior regarding the preservation of the viability of the lines vis-à-vis the duration of the given condition.

The significance of both components shows that the response of the lines to the retention factor cannot be quantified strictly after a linear or non-linear dependence so according to a certain equation.

Table 6. The nature of effects of "storage duration" factor on inbred lines germination capacity

SOURCE OF VARIABILITY	DEGREE OF FREEDOM (df)	SUM OF SQUARES [SS]	MEAN SQUARE [s_i^2]	COMPUTED "F"
Replication (σ_R)	3	14.01	$s_R^2=\delta_R*N/df_R=4.67$	
INBRED LINES (L)	3	3222.72	$s_L^2=\delta_L*N/df_L=1074.24$	347.08***
DURATION STORAGE, (Δ)	3	7184.31	$s_\Delta^2=\delta_\Delta*N/df_\Delta=2394.77$	-
Linear (Δ_L)	(1)	6835.75	6835.75	2208.64***
Quadratic(Δ_Q)	(1)	301.89	301.89	97.54**
Residual (Δ_{rez})	(1)	46.67	-	-
INTERACTION,: L X Δ	9	5179.59	$s_{L*\Delta}^2=\delta_{L*\Delta}*N/df_{L\Delta}=575.51$	-
L X Δ_L - Linear	(1)	4217.96	4217.96	1362.83***
L X Δ_Q - Quadratic	(1)	831.422	831.422	268.63***
L X Δ_{rez} - Residual	7	130.208	-	-
ERROR.	45	139.275	$s_E^2=\delta_E*N/df_E=3.095$	

Basically, this means that the reactions of the lines vis-à-vis the duration of the retention under the given conditions ***are unpredictable***. It is possible to study further to determine which of the inbred lines in combination with the retention factor, give a predominant response after nonlinear dependence.

CONCLUSIONS

The control and management of the factors of the storage environment, can extend the useful life of the lot.

The experimental results obtained show that treating the seed of hybrids, with fungicide, before storage, their germination, have a better conservation, which proves to be a solution, in increasing the longevity of the seed lots By developing a complex equation of seed viability, it is possible to predict the germination of seed lots belonging to the hybrids studied after a period of storage, useful information for those in the seed industry, avoiding the declassification of the batches, as a result of the decrease of germination below the allowed limit, which has consequences in terms of economics and the safety of production.

Regarding the resistance and the preservation of the initial properties vis-à-vis the storage conditions in the case of the inbred lines stored in the dry state in open warehouses, there is a weaker preservation of the initial qualities than in the case of maize hybrid seed The inbred lines react specifically to the methods of maintaining the viability value, and their reactions vis-à-vis the duration of the preservation under the given conditions, are unpredictable due to the fact that they differ in terms of the degree of homozygosity. The process of deterioration of the seeds belonging to the inbred lines and the analyzed hybrids is inevitable and continuous, but it does not develop with the same intensity for all genotypes and lines studied.

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