APPRECIATION OF THE FACTORS' INFLUENCE ON THE VIGOR - I INDEX, TREATMENT x GENOTYPE x STORAGE DURATION OF CORN SEEDS (*ZEA MAYS* L.)

APRECIEREA INFLUENȚEI FACTORILOR ASUPRA INDEXULUI VIGORII-I, TRATAMENT x GENOTIP x DURATA PĂSTRĂRII LA SĂMÂNȚA DE PORUMB (*ZEA MAYS* L.)

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Abstract. *The size of the values of the parameters that characterize the quality of the seed from the aspect of the physiological and physical manifestation, has a very important role in the measures to improve the cultivation technologies for obtaining safe and superior harvests qualitatively and quantitatively, therefore it is necessary to promote a seed with high biological value, high production capacity, resistance to diseases, pests and stress conditions. The particularity of the seeds destined for sowing is that they can be kept in different forms for a longer period of time, offering the safety of production. Analysing the data by the size of the range and the size of the coefficient of variation (Cv) it can be seen that there are obvious differences between the variants, regarding the value of these indicators. There were large decreases in the values of the index the force registered in this stage "after 12 months", in the variant treated with fungicide + insecticide, except for Turda 200 and Turda Star hybrids.*
Key words: hybrid, quality, analysis, corn, batch

Rezumat. *Mărimea valorilor parametrilor ce caracterizează calitatea seminței sub aspectul manifestării fiziologice şi fizice are un rol foarte important în cadrul măsurilor de îmbunătățire a tehnologiilor de cultură pentru obținerea unor recolte sigure şi superioare din punct de vedere calitativ şi cantitativ, de aceea este necesar a promova o sămânță cu o valoare biologică ridicată, capacitate de producție mare, rezistență la boli, dăunători şi condiții de stres. Particularitatea semințelor destinate însămânțării este că acestea pot fi păstrate sub diferite forme pe o perioadă mai lungă de timp, oferind siguranța producției. Analizând datele după mărimea intervalului şi mărimea coeficientului de variație (Cv) se poate constata, că există diferențe evidente între variante, în ce priveşte valoarea acestor indicatori. S-au constat scăderi mari ale valorilor indexului vigorii înregistrați în această etapă „după 12 luni", la varianta tratată cu fungicid+insecticid, exceptând hibrizii Turda 200 şi Turda Star.*
Cuvinte cheie: hibrid, calitate, analize, porumb, lot

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INTRODUCTION

The evaluation and identification of high-performance seed lots is an important initiative, which contributes to the success of the production even from the sowing phase, by using for the purpose proposed seeds with an active state of health, natural resistance, able to develop normal germs and to ensures a uniform sunrise.

It is necessary to know the real status of a lot of seeds in terms of quality, to provide the necessary information to the user, helping him to decide the way, the conditions and the moment of use of the lot. Different batches of seeds, even if they have the same (sometimes almost identical) germination, does not mean that they have the same physiological potential, that is to say, when sowing in the field, they do not have the same germination and germination.

In order to maintain seed viability at a high-level during storage, it is compulsory to select for seed, seeds that have high levels of viability before storage (Modi, 2004). According to Burris (2000), the quality of the seeds influences the production (Burris, 2000) in the vast majority of the cultivated species, but especially in the case of maize, and Hermanus-Maree (2008) in the work "Prediction of Field Emergence of maize hybrids exposed to cold and wet conditions", specifies that the physiological potential of the seed, respectively its quality, can be evidenced by two fundamental components of it, namely, the viability and vigour of the growths (Hermanus-Maree, 2008). Initially, these two terms were used confusingly to define seed performance.

If things are simple in the case of viability - rendered by the percentage of seeds with live embryos, regarding the term of force, things are much more complex. The International Congress of the "Seed Testing Association" (ISTA), held in Washington (1950), on the topic of seed quality, identifies the force as a component of the physiological potential of the seed, independent of the germination indicator, and expresses its confidence that it is a separate and essential component of seed quality (Marcos-Filho, 2015).

Milosevic and Cirovic (1994) state that in order to obtain accurate information about the quality of a lot of seeds, different vigour tests must be used (Milosevici and Cirovic, 1994). The germination reflects the maximum germination potential of the seeds under optimal conditions, correlating with the emergence in the field only if, there are almost optimal conditions, so it is not a good indicator, to correlate with the emergence in the field, instead the size of the growth and the dry weight of these increases and a series of combined indicators, besides the fact that they are good indicators, correlated with the emergence in the field, also helps to differentiate the lots of seeds regarding the expression of the physiological potential (Divsalar *et al.,* 2013).

Measurements on growth and then the indicators calculated as a combination of germination and growth size play a very important role in predicting good seed behaviour in the field (Copeland and Mcdonald, 1995).

MATERIAL AND METHOD

The hybrids taken in the study were produced at the Agricultural Research and Development Station Turda is located in the north western part of the municipality of Turda, Cluj county. Their cultivation was on a soil with a clay-clay texture, with a neutral pH on 0-20 cm and weak acid on 20-40 cm depth, good and very good supply with NPK and microelements the soil content in humus being medium, according to the analyses made by the specialized laboratory.

Studied hybrids are:

- ✓ TURDA 200, double hybrid, early, FAO group 290, serrated grain, yellow-gold color, MMB 260-330g, grain / chick percentage 76-79%, fat content of coil 4.0-5.4; average production potential 8,100-10,600 kg / ha; It is noted by its adaptability to a wide range of ecological and technological conditions, through the possibilities of capitalizing on the intensive technological conditions, as well as through the good and stable production results during the almost 40 years of use in culture (1976-2015);
- ✓ TURDA 165, trilinear hybrid, early FAO group 280, serrated bob, medium high waist; the earliest Romanian hybrid in culture, good resistance to fall of plants; MMB 300-330 g, percentage of grains / stalks 80-83%, content of starch rich 70-72%, production potential 10.700-13.700 kg / ha;
- ✓ TURDA 201, trilinear hybrid, semi-impure, FAO 340 group, toothed grain, good resistance to cryptogamic and harmful diseases and plant fall; MMB 315-335g, percentage of grains / stalks 80-83%, starch rich content 70-74%; production potential of 9.000-13.600 kg / ha;
- ✓ TURDA FAVORIT, simple hybrid, semi-impure, FAO 380 group, very good resistance to falling and breaking the stems, good resistance to diseases and pests; semi-serrated grain, yellow-gold color, MMB 280-310g, percentage of grains / stalks 78-82%, starch rich content 70-73%; production potential of 10,000-13.500 kg / ha, at a density of 60-65000 plants / ha;
- ✓ TURDA STAR, trilinear hybrid, semi-impure, FAO 370 group, good resistance to low temperatures from the first part of the vegetation period, to fall and break, drought, burns, bean disease, diseases and pests; serrated grain, yellow color, MMB 310g, grain / grain percentage 79-82%, starch rich content 70-71%; production potential of 10,000-12.800 kg / ha the pleasant appearance (stay green) of the plants at physiological maturity, the saps are easily harvested.

The inbred lines taken in the study: LC 223 Nrf.T; LC 223 Nrf.C; LC 363; LC 763, are parental forms of simple commercial hybrids or pollinating (paternal) forms of trilinear hybrids.

At the end of the germination test (after 7 days), 5 seedlings from normal germs were selected randomly, from each repetition, retaining only the seedlings from 3 repetitions.

RESULTS AND DISCUSSIONS

Considering the importance of this index in the appreciation of the vigour of the seeds, respectively their performances during the germination and emergence in the field, as well as a good indicator, used in the differentiation of the lots in terms of quality (Gupta, 1993), it was considered to be necessary that besides the average the result of each experimental variant to present the main indicators of the dispersion: the variance, the amplitude of the variation and the coefficient of variability (tab. 1).

Analysing the data by the size of the range and the size of the coefficient of variation (Cv) it can be seen that there are obvious differences between the variants, regarding the value of these indicators. The close values of the interval indicate a grouping of the observations of the repetitions around the mean, of course this case also corresponds to small values of the coefficient of variability (tab. 1).

Table 1

Variability of the distribution of results in the vigour – I index analysis

TREATMENT	HYBRID	BEFORE SOWING		AFTER 12 MONTHS		AFTER 24 MONTHS		AFTER 36 MONTHS	
		$\bar{I}_{index} \pm t_{5\%} * s_{index}$	Cv[%]	$\bar{I}_{index} \pm t_{5\%} * s_{index}$	Cv[%]	$\bar{I}_{index} \pm t_{5\%} * s_{index}$	Cv[%]	$\bar{I}_{index} \pm t_{5\%} * s_{index}$	Cv[%]
UNTREATED	Turda 200	3425.3-3810.7	2.1	3312.2-3711.2	2.3	3132.5-3567.5	2.6	3019.2-3447.4	2.6
	Turda 165	3165.2-3521.4	2.1	3091.3-3518.7	2.5	2742-3258	3.4	2392-2908	3.9
	Turda 201	4788.6-5137.8	1.9	3333.5-3735.1	2.2	2942-3458	3.2	2523-3110.4	4.2
	Turda Star	3368.3-3724.3	2	3518.5-3791.5	2.6	3079.9-3653.5	3.4	2928.5-3504.9	3.6
	Turda Favorit	3201.8-3580.2	2.2	3039.2-3627.4	3.5	2802-3398	3.8	2680.8-3225.2	3.7
CONTROLLED ENVIRONMENT	Turda 200	3424.3-3811.7	2.1	2769.2-3246.8	3.1	1909.2-2455.4	5	1456.2-2051.4	6.8
	Turda 165	3165.4-3521.4	2.1	2304.5-3012.3	5.3	954.9-1724.5	**11.5**	830.2-1623.2	**13**
	Turda 201	3491.7-3841.7	1.9	2380.9-3075.7	5.1	1129.1-1898.9	**10.2**	639.1-1408.9	**15.1**
	Turda Star	3368.3-3724.3	2	2882.9-3356.1	3.05	1726.6-2406.8	6.6	1263.7-1936.3	8.4
	Turda Favorit	3201.8-3580.2	2.2	2207.7-2925.7	5.6	1009.3-1768.7	**11.04**	852.7-1647.3	**12.8**
FUNGICID	Turda 200	3505.2-3864.8	2.02	3577.2-4017.6	2.3	3448.6-3885.4	2.3	3126.6-3573.4	2.6
	Turda 165	3376.8-3769.8	2.2	3447.6-3884.4	2.4	2853.7-3337.1	3.1	2225.4-2746.6	4.2
	Turda 201	3717.4-4104.6	1.9	3676.6-4130	2.3	3067.5-3638.5	3.4	2600.2-3171.2	3.9
	Turda Star	3638.2-3985.8	1.8	3572-3994	2.2	3298-3720	2.4	2797.9-3244.7	2.9
	Turda Favorit	3509.9-3946.7	2.3	3418.5-3989.5	3.1	2810.6-3366.6	3.6	2718.1-3313.9	3.9
FUNGICID + INSECTICID	Turda 200	3663.5-3936.5	1.4	3544-3966	2.2	2041.8-2631.6	5.1	1781.9-2387.5	5.8
	Turda 165	3437.2-3834.4	2.2	2634.2-3239.8	4.1	996.1-1740.9	**10.9**	665.8-1460.2	**15.4**
	Turda 201	3764.2-4235.8	2.3	3099.7-3720.3	3.6	1448.5-2218.1	8.4	1043.4-1862.6	**11.3**
	Turda Star	3646.8-4019.2	1.9	3459.9-3906.7	2.4	2127.1-2722.9	4.9	1789.7-2410.3	5.9
	Turda Favorit	3542-3964	2.2	2607.5-3178.5	3.9	1222.7-1977.3	**9.5**	860.8-1672.6	**12.9**

It is found that as the storage time increases, at each treatment level and in the case of each hybrid, the values of the coefficient of variability increase. Also, these values are much higher in the variants in which the seed is subjected to stress reaching in some cases at levels above the average variability. This fact explains the different reaction of hybrids to the force in such environments. However, most of the values of the coefficients of variation have values below 10%, which proves that the experimentation was done correctly, and the results have scientific value.

It has been shown previously that the values of the recorded increases, as well as the values of the vigour-I index, are dependent on the duration of storage, treatment and genotype.

Taking into account the structural circle in which the hierarchy of these factors regarding the contribution to the total variability is shown, as well as the conclusions regarding the hard-to-describe reactions regarding the behaviour of these hybrids under different experimentation conditions, it was sought to establish by the known mathematical procedures, the laws of variation of these structures as well as of the index of vigour, to describe as accurately as possible the reactions of the studied hybrids, to the irreversible process of aging and the storage media.

The suitability of these dependencies was assessed by the values of the coefficient of determination R^2 (tab. 2) and the recording of the smallest values for the residual variance.

As can be seen the form of these laws chosen as appropriate is very varied, from those in linear form to those of the exponential form.

Table 2

Functional dependences of vigour-I index

Treatment	Average of vigour-I index				The law of appropriate variation	The regression coefficients	Correlation (R^2)
	Before	12 months	24 months	36 months			
Untreated	3513.08	3447.86	3203.34	2973.94	$y=a+b*x$	a= 3563.846 b= -15.516	0.95
Controlled environment	3513.08	2816.38	1698.34	1370.90	$y= a*b^x$	a= 3609.603 b= 0.972	0.97
Fungicide	3740.98	3770.74	3342.60	2951.80	$y=a*x^2 + b*x+c$	a= -0.730; b= 2.987 c=3765.742	0.93
Fungicide + insecticide	3804.36	3335.66	1912.10	1588.08	$y=a*x^2 + b*x+c$	a= 0.251; b= -76.312 c=3907	0.94

This shows that the aging process of the seeds belonging to the studied hybrids is complex, the phenomena and the biochemical and physiological processes that occur inside the seeds as they grow older, are influenced by the genetic particularities of the genotype but also by the storage conditions.

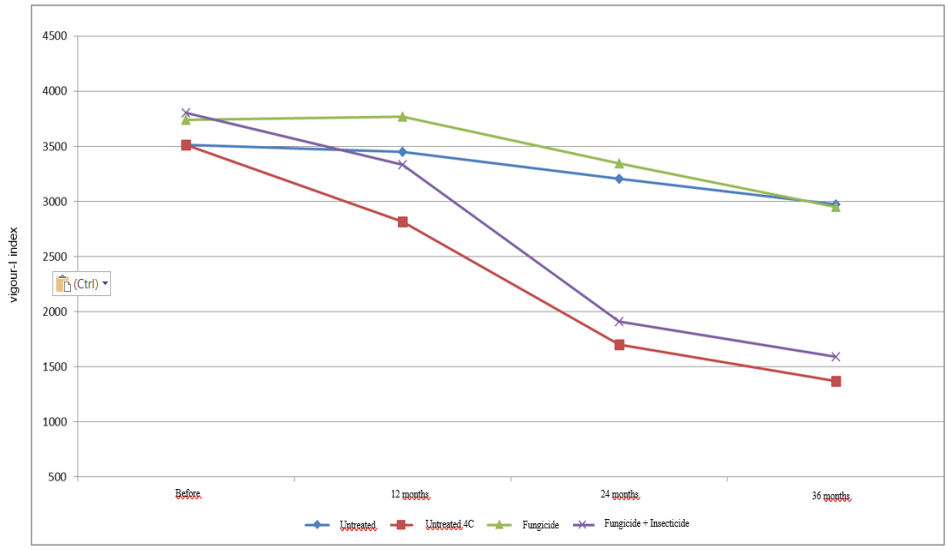

Fig. 1 Variation of hybrids vigour-I index during storage duration

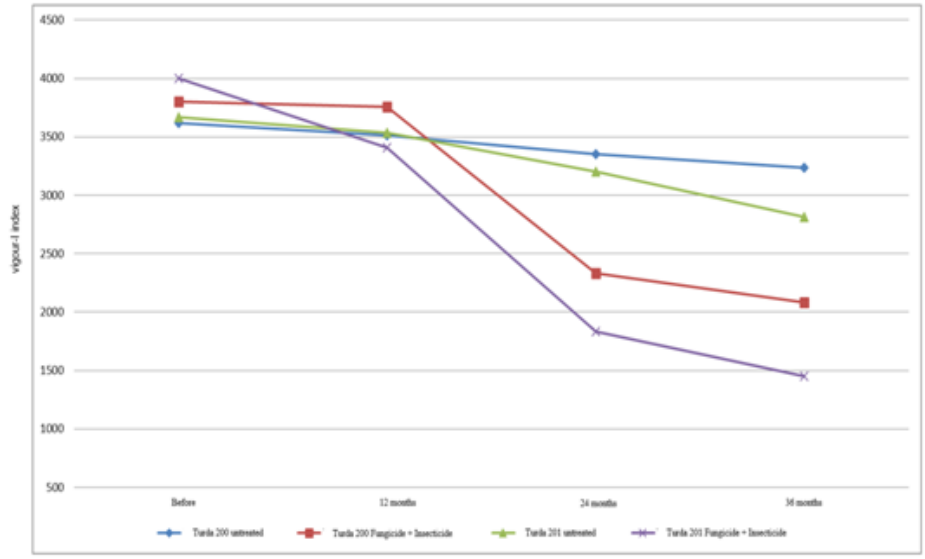

Fig. 2 The comparative study of vigour-I index for hybrids Turda 200 and Turda 201 in environment: untreated and treated with fungicide + insecticide

For a more obvious presentation of the variation of the values describing the index of force using our average values, its evolution during the retention period was graphically represented (fig. 1) and a comparative graphical representation for two Turda 200 and Turda 201 hybrids in two distinct environments: untreated and treated with fungicide + insecticide (fig. 2).

In both graphs, in the "untreated environment" you can see a natural evolution of this indicator, but in the other environments the evolution is difficult to describe. There is a “break” in the values recorded for this index between the stages “after 12 months” and “after 24 months”.

Thus, the rate of growth that directly influences the size of the index of vigour I, slows down in the variants in which the seed is subjected to stress, seems from a certain moment. It can be seen in figure 2 the good resistance with the shelf life and under stress conditions of the Turda 200 hybrid.

CONCLUSIONS

1. In the variant in which the seed was subjected to stress, for example the Turda 165 hybrid, it also has in the "after 12 months" stage the same germination of 92% as the one from the initial moment. The same is true of the Turda 201 hybrid, but after this retention period, in this environment, the force index records, for both hybrids, drastic decreases.

2. There were large decreases in the values of the index of force registered in this stage "after 12 months", in the variant treated with fungicide + insecticide, except for Turda 200 and Turda Star hybrids.

3. With the increase of the retention period (after 36 months) pronounced decreases of the value of the index of force were registered in all hybrids.

4. If obvious decreases of germination were recorded "after 24 months" of storage, in the case of the recorded values and the graphs plotted, for the index of force, a break in the values between the stages "after 12 months" and "after 24 months" is observed. This observation has great practical utility.

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