RESULTS OF QUALITY TRAITS TESTING FOR MAIZE IN CONTROLLED ENVIRONMENT

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Abstract

Maize is one of the most often cultivated species around the world, due to its high yield and also due to its use in different food, animal husbandry and industry production. Yield maximization needs considering the hybrid characteristics related to pedo-climatic conditions, pathogen and insects, maturity group, soil moisture and temperature at sowing. In the late years, early sowing for maize has become more frequent in Romanian farms and choosing the right hybrid has great importance. One of the main objectives is choosing the hybrid with seeds that produces strong plants after sowing, in wet and cooler soil conditions. Ten maize genotypes were tested regarding seed germination using four methods: standard germination test at 25 degrees C, cold test, Pioneer stress test and accelerating aging test. The results highlighted one genotype with great performance in all four tests. Eight genotypes had good overall results and only one of them recorded low values.

Key words: maize, genotype testing, seed germination

Maize is one of the most cultivated species around the world, due to its high yield capacity but also due to its various uses in animal husbandry, industry and human consumption.

The increased yields of grains or green mass, together with a great diversity of its valorization possibilities, through various processing methods, have determined that this crop is among the most important components of modern intensive agriculture and implicitly, of the programs of economic and social development.

Selecting the best hybrid is, probably, the most important management decision to take by farmers. Choosing the right hybrid and the correct density bring 30% of the final yield, so great attention must be paid to these two elements.

In 2021, in Romania, maize was sown on 2493000 ha, with total seed production of 14445000 tones (www.insse.ro).

Maize is sown in early spring, when soil temperatures can be sometimes low, and so the seeds imbibe, but do not germinate and are attacked by soil fungus. Therefore, it is necessary to evaluate the hybrids that a farmer intends to sow, in order to obtain high yields that are not affected by early sowing in wet and cold soil in spring (Woltz J.M. and TeKrony, D.M, 2001; Lovato *et al*, 2005, Matthews S. and Khajeh Hosseini M.K, 2006).

In order to determine the seed quality, germination tests are carried out, in controlled conditions of substrate and temperature, in which the optimum temperature is the one in which highest germination percentage is obtained within the shortest period of time (Lopes J.C. *et al*, 2005).

The aim of the research was to evaluate the germination of maize seeds under four tests taken into study: standard germination test at 25 degrees C, cold test, Pioneer stress test and accelerating aging test.

MATERIAL AND METHOD

The research was carried out in 2021 at the Research Institute for Agriculture and Environment, belonging to Iasi University of Life Sciences.

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The maize seeds were provided by the Romanian Assosciation of Maize Producers, and they belonged to 10 different hybrids, coded from 1 to 10.

Standard Germination Test (SGT). For this test, 50 seeds, in 4 replications, were sown in boxes containing vermiculite (*figure 1*). The boxes were kept in the Fitotron® Growth chambers - Weiss Technik at a temperature of 25 ^{o}C for 7 days. The vermiculite was kept with proper moisture, using bi-distilled water. The viable sprouted seedlings were counted in the 8th day.

Figure 1 **Standard Germination Test**

Cold Test (CT%). The Cold Test (CT%) was performed to determine the behavior of the seeds in suboptimal conditions (high humidity/low temperatures), similar to field conditions after sowing. It shows seed vigor. Low vigor seeds will have poor germination and slow growth in response to induced stress. For this, 50 seeds, were sown in 4 replications, in boxes containing vermiculite. The boxes were kept in the Fitotron® Growth chambers - Weiss Technik at a temperature of 10 ^{o}C for 7 day. The substrate was kept with proper moisture (75%), using bi-distilled water. In the 8th day, temperature was increased to 25 ^{o}C for 5 days, with a lighting regime of 12 hours light / 12 hours darkness and air humidity of 50%. The evaluation was carried out after 5 days (*figure 2*).

Figure 2 **Cold Test**

Pioneer Stress Test (PST). For this test, 50 seeds, in 4 replications were placed between paper towels and moistened double-distilled water for 3 days at 4 ^{o}C, this way being simulated the conditions with humidity and low temperatures in spring. Three days later, the seeds were sown in polypropylene boxes with vermiculite substrate, watered daily with demineralized water and kept at 25 ^{o}C in the climatic chambers for 6 days.

the light regime was 12 hours of light and 12 hours of darkness, and the air humidity was 50%. After this period, an evaluation was made, quantifying the normally developed plants (figure 3).

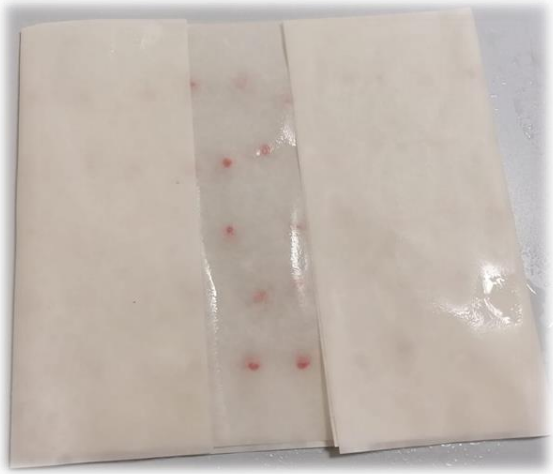

Figure 3 **Pioneer Stress Test (PST)**

Accelerated Aging Test (AAT). The test consists of moistening the seed with an amount of water above the normal limit and keeping it at a high temperature of 45°C and a relative humidity of around 100%, for a short period of time (72 hours). The seeds are then placed in optimal germination conditions. High vigor genotypes will withstand these extreme stress conditions and deteriorate at a slower rate than low vigor genotypes. Fifty seeds in 4 replications were placed in a perforated polypropylene jar, which allows the seeds to be in contact with the atmosphere saturated in water vapor. In turn, this jar was inserted into one with a capacity of 300 ml, filled with approx. 100 ml of distilled water and featuring a cap that allows for a tight squeeze (figure 4). The jars were placed in a forced convection oven and maintained for 72 hours at 45 °C, and after that, the seeds were sown in polypropylene boxes, in vermiculite and watered with the same amount of distilled water. The boxes were then placed in the climatic chambers, at a constant temperature of 25 °C, relative humidity of 50% and a photoperiod of 12 hours, for the germination test.

Figure 4 **Accelerated Aging Test**

RESULTS AND DISCUSSIONS

The results for the Standard Germination Test are presented in *table 1*.

Table 1

GERMINATION AT 25 °C, MAIZE, 2021

Hybrid	Germination (%)	% compared to witness	Differences compared to average	Signification
4	99.0	101.96	1.9	
6	99.0	101.96	1.9	
8	99.0	101.96	1.9	
10	99.0	101.96	1.9	
2	98.5	101.44	1.4	
3	98.5	101.44	1.4	
1	98.0	100.93	0.9	
average	97.1	100.00	0.0	control
5	94.5	97.32	-2.6	
9	93.0	95.78	-4.1	o
7	92.5	95.26	-4.6	o

DL5%=4.1, DL1%=5.5, DL0.1%=7.3
(average = control, is the average of the experiment)

The statistical analysis showed that only two of the 10 hybrids taken into study had significant negative differences compared to the average of the experience. The hybrid no. 9 had a difference of -4.1% compared to the control, and hybrid no. 7 had -4.1% compared to the control.

Regarding the results obtained for the Cold Test, they are presented in *table 2*.

Table 2

COLD TEST, MAIZE, 2021

Hybrid	Germination (%)	% compared to witness	Differences compared to average	Signification
6	97.0	115.61	13.1	xx
8	95.5	113.83	11.6	x
10	94.0	112.04	10.1	x
3	93.0	110.85	9.1	x
1	91.0	108.46	7.1	
2	87.5	104.29	3.6	
average	83.9	100.00	0.0	control
9	81.5	97.14	-2.4	
5	80.0	95.35	-3.9	
4	78.5	93.56	-5.4	
7	41.0	48.87	-42.9	ooo

DL5%=8.0, DL1%=10.9, DL0.1%=14.6
(average = control, is the average of the experiment)

The germination analysis throughout the cold test at 10°C shows a greater variation of the results, the values ranging between 41 and 97%.

The results are of course in concordance with the results of the previous test, hybrids no. 9, 5 and 7 having values below the control.

The Pioneer Stress Test (PST) results are presented in *table 3*.

Table 3

PST, MAIZE, 2021

Hybrid	Germination (%)	% compared to witness	Differences compared to average	Signification
8	98.0	113.03	11.3	xxx
1	97.5	112.46	10.8	xxx
3	97.0	111.88	10.3	xxx
2	95.5	110.15	8.8	xxx
10	94.0	108.42	7.3	xx
4	91.5	105.54	4.8	x
5	91.5	105.54	4.8	x
average	86.7	100.00	0.0	control
6	84.5	97.46	-2.2	
9	72.0	83.04	-14.7	ooo
7	45.5	52.48	-41.2	ooo

DL5%=4.6, DL1%=6.2, DL0.1%=8.3
(average = control, is the average of the experiment)

Is considered that a hybrid has excellent traits if the percentage for normal plants after the PST is above 75%. From the data obtained, we notice that 8 of the 10 hybrids taken into study had values that exceeded 75%, from which the hybrids no. 9, 1 and 3 with a germination percentage between 97 and 98%, being above the control with at least 10.3%. On the other hand, hybrid no. 7 had only 45.5% of normal seedlings, indicating that it has issues related with the thermic stress during the spring.

Seven genotypes had higher values compared to the control, with positive significant, distinct significant and very significant differences compared to the control. Hybrids no. 9 and 7 had negative very significant differences compared to the average.

The results for the last test performed, the Accelerated Ageing Test are presented in *table 4*.

Table 4

ACCELERATING AGEING TEST (25 °C), MAIZE, 2021

Hybrid	Germination (%)	% compared to witness	Differences compared to average	Signification
8	96.5	120.63	16.5	xx
10	96.0	120.00	16.0	xx
6	95.0	118.75	15.0	xx
5	90.0	112.50	10.0	x
3	87.5	109.38	7.5	
4	82.0	102.50	2.0	
2	81.0	101.25	1.0	
average	80.5	100.00	0.0	control
9	76.0	95.00	-4.0	
1	69.5	86.88	-10.5	o
7	31.0	38.75	-49.0	ooo

DL5%=9.3, DL1%=12.5, DL0.1%=16.7
(average = control, is the average of the experiment)

For this test also, hybrids no. 9 and 7 had values below the control.

CONCLUSIONS

Choosing the right maize hybrid, it's the most important decision a farmer has to take, in order to have high yield even for an early sowing.

The Standard Germination Test, The Cold Test, The Pioneer Stress Test and the Accelerated Ageing Test were developed to simulate adverse field conditions and measure the ability of seeds to emerge. They are the most widely used vigor tests for maize.

From all 10 hybrids that were tested, one had very good results for all tests, 8 had good results, depending on the test, and one had lower values in all situations.

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