QUALITY TRAITS TESTS OF SUNFLOWER SEEDS IN FITOTRON GROWTH CHAMBERS

Tudor George AOSTĂCIOAEI[1], Anca Elena CALISTRU[1], Gabriel Dumitru MIHU[1], Vlad ARSENOAIA[1], Denis ȚOPA[1], Gerard JITĂREANU[1]

e-mail: aos.tudor@yahoo.ro

Abstract

It is well known that global climate change is one of the greatest threats to the environment and the social and economic sector. Therefore, it is necessary to develop strategies and actions to adapt to the impact of climate change, and to find ways and methods of preventing, limiting and combating the often disastrous effects, while at the same time respecting the principle to preserve the environment and ensure the food needs of a growing population. As a result of this problem, changing weather patterns, by shifting the sowing seasons of agricultural crops to avoid periods of water stress, increases the responsibility of seed producers for the adaptability of the hybrids they produce. In the same way, the institutions responsible for certifying the material used for sowing have a key role to play in improving methods and techniques for testing new hybrids for quality and resistance. Thus, in the Fitotron of the Research Institute for Agriculture and Environment (R.I.A.E), belonging to Iasi University of Life Sciences (I.U.L.S), respectively in the Weiss Gallenkamp climate-controlled growth chambers, a number of 10 sunflower hybrids, supplied by the Association of Romanian Maize Producers (A.R.M.P), were tested to determine the germination capacity under stress factors. The results obtained from the tests indicate a variation in the germination capacity of the hybrids, both under optimum growth conditions and under temperature and humidity stress.

Key words: germination, sunflower, growth chambers, climate change

Sunflower (*Helianthus annuus* L.) is one of the four most important annual crops grown for vegetable and industrial oils in the world (Ekin Z. *et al*, 2005) and belongs to the family Asteraceae. Helianthus genus contains 65 different species (Andrew R.L. *et al*, 2013).

The name Helianthus, being derived from *helios* (the sun) and *athos* (a flower), has the same meaning as the English name Sunflower, which has been given to these flowers from a supposition that they follow the sun by day, always turning towards its direct rays. The sunflower that most people refer to is *H. annuus*, an annual sunflower. In general, it is an annual plant which possesses a large inflorescence (Flowering head), and its name is derived from the flower's shape and image, which is often used to depict the sun. The plant has a rough, hairy stem, broad, coarsely toothed, rough leaves and circular heads of flowers (Khaleghizadeh A., 2011).

The heads consist of many individual flowers which mature into seeds on a receptacle base (Seghatoleslami M.J. *et al*, 2012).

Sunflower seeds are an excellent source of vitamin E and polyunsaturated fatty acids. These natural antioxidants and polyunsaturated fatty acids have protective effects on hypertension and cardiovascular disease (Cho M.H. *et al*, 2008).

Production of high-quality seed is main prerequisite for maximal exploitation of cultivar genetic potential. Yield of sunflower grain varies significantly because of considerable influence of weather conditions, especially precipitation and temperature changes during a growing season. However, sunflower germination can be very susceptible in real conditions of field because of bad seed bed preparation and varying environment (Moghanibashi M. *et al*, 2012).

Germination is an important stage of plant development. This stage of the plant life cycle has a combination of multiple catabolic and anabolic processes and also being

[1] Iasi University of Life Sciences, Romania

considered to improve the medicinal qualities of seed (El-Adawy T.A. *et al*, 2003).

Seed germination and seedling emergence result from a sequence of biological events initiated by water imbibition followed by enzymatic metabolism of storage nutrients, but regulated by the environment and the quality of the seed (Maroufi K. *et al*, 2011).

According to the literature data the quality of seed is influenced by: weather conditions of production, presence of pests in the field, grain oil content, damage of grains in processing, manner and period of grain storage, packaging, favorable water content, conditions and duration of storage, pesticide influence, temperature seeds are preserved at biochemical degradation of seed tissue, disease and pests incidence and high oil content (Kostic M. *et al*, 2009).

One of the tests for determining seed quality level is the germination test, which is performed under temperature and substrate conditions ideal for each species. Among the environmental factors that affect seed germination, temperature has an effect on speed of germination and on germination potential. The temperature defined as optimum is that at which the highest germination percentage is obtained within the shortest period of time (Lopes J.C. *et al*, 2005). A temperature above the optimum increases the speed of germination (Marshall B. and Squire G.C., 1996), whereas low temperatures delay emergence and lead to the formation of small seedlings (Szopińska D. *et al*, 2007). The substrate used in the germination test, in general, has the purpose of sustaining the seeds (Lopes J.C. and Pereira M.D., 2005).

The choice of substrate should consider seed size, its requirements in relation to light, and ease in counting operations and seedling evaluation (Figliolia M.B. *et al*, 1993). The structure, aeration, water retaining capacity, and degree of infestation of pathogens in the substrate have a big effect on germination (Moraes L.A.C. *et al*, 2007).

The substrate must be chosen in accordance with seed demands. Seed germination is dependent upon a multitude of endogenous and exogenous factors such as temperature. It is the main factor that regulates the germination process of seed. There are three cardinal temperatures that influence the germination: lowest, optimal, and high temperature (Vicente M.J. *et al*, 2020).

Changes in temperature occur faster than any other environmental stress factors brought about by climate change. It is expected that there will be an increase of 2.3 ± 0.3 °C thresholds in world temperature in the next few years, as reported by Brown P.T. and Caldeira K. (2017). This poses a threat to many crops as the high temperature is known to negatively affect the survival and germination of seeds.

The aim of the research was to evaluate the germination of sunflower seeds both under optimum growth conditions and under stress factors in Weiss Gallenkamp climate-controlled growth chambers.

MATERIAL AND METHOD

The research was carried out in the Fitotron® of the Research Institute for Agriculture and Environment, belonging to Iasi University of Life Sciences, which is equipped with 11 Weiss Gallenkamp climate-controlled growth chambers *(figure 1*).

Figure 1 **Walk-in Plant Growth Room**

In 2022, Association of Romanian Maize Producers (A.R.M.P) provided for the R.I.A.E 10 coded sunflower hybrids for germination tests.

The Phytotron is composed of a group of Walk-in Plant Growth Rooms which allow researchers to maintain controlled growing conditions of temperature (-20ºC to +55ºC), humidity (40%RH to 95%RH) and light intensity (10-100%). Weiss Gallenkamp operates in a number of key sectors including plant growth research, pharmaceutical stability testing,

automotive environmental testing and aerospace environmental testing.

For germination tests, sunflower achenes were randomly selected from a seed plot, regardless of size and shape. Each test was carried out in 3 replicates of 50 seeds/replication for each of the 10 hybrids.

Standard Germination Test (SGT)

Seeds are tested for germination to determine how they will perform in the field, after sowing. This parameter is also included in the calculation of the seed norm.

For this test we sowed 50 seeds in plastic boxes, using 7-8 cm horticultural vermiculite as substrate. After that we placed the boxes in the growth chamber at a temperature of 25°C for 7 days. During this period, the vermiculite boxes were watered daily with double distilled water. Atfer 7 days, viable seedlings were counted *(figure 2).*

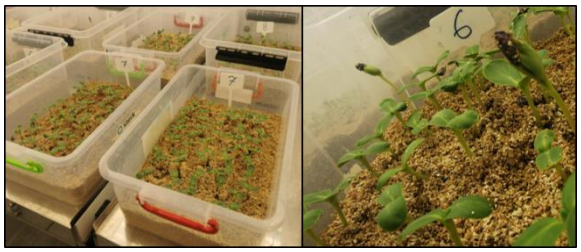

Figure 2 **Standard Germination Test**

Accelerated Aging Test (AAT)

The Accelerated Aging Test is used to estimate the potential field emergence, storability, longevity of viability. AAT is occasionally used for a vigor test for sunflower. As methodology, the seeds were aged for 72 hours at 43°C in a high humidity regime. After aging, each repetition of 50 seeds was sown in plastic boxes with vermiculite and placed in climate chamber at 25°C. Seedlings were evaluated 10 days after sowing and the results were reported as a percentage, which represents the number of seedlings categorized as "normal". A "good" AAT result is 80% or higher.

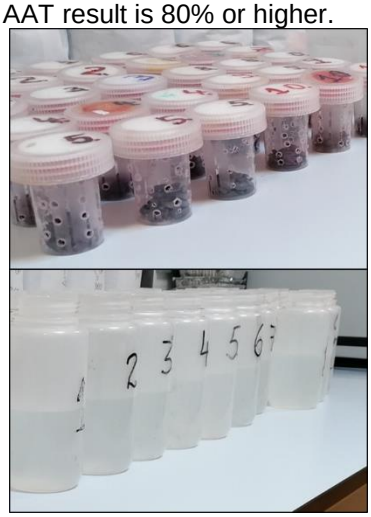

Figure 3 **Accelerated Aging Test**

RESULTS AND DISCUSSIONS

The results of the tests are presented as percentages in *table 1*.

Table 1

Test results (%)

Coded Sunflower Hybrid	Test performed	
	Standard Germination	Accelerated Aging
1	90	65.3
2	98	96.7
3	99.3	86.7
4	92.7	83.3
5	92.7	64
6	95.3	80.7
7	97.3	90.7
8	82.7	46.7
9	90.7	86.7
10	97.3	86

Regarding the results obtained in the standard germination test of the 10 sunflower hybrids, it is observed that the values ranged from 82.7% to 99.3%. The average over the whole experiment was 93.6%.

A clear understanding of the germination and seedling growth is useful in screening for tolerance of crops and cultivars either to low or to high temperatures (Vassilevska-Ivanova R., Tcekova Z., 2002).

Sunflower seeds lose their vigor during storage at high temperature and high relative humidity (Kausar M. *et al*, 2009). This was also observed by performing the accelerated aging test because the percentage values were lower compared to results obtained under optimum growth conditions, at 25°C (SGT). Overall, these values fluctuated between 46.7% and 96.7% with an average over the whole test of 78.7%.

After analysing the data, it can be observed that hybrid no 8 had the lowest germination values in both tests, while the hybrid coded 2 had the best values in the same case. The highest germination value under optimum conditions was recorded by the hybrid 3, 99.3%.

The results obtained from the tests indicate a variation in the germination capacity of the hybrids, both under optimum growth conditions and under temperature and humidity stress.

CONCLUSIONS

One of the factors limiting production potential of the sunflower crop is the quality of the seed. High quality seed must possess a number of attributes in addition to genetic value, biological purity and vigour indices.

Using this type of seed in cultivation contributes to the optimum expression of the productive and qualitative potential of the hybrid grown. The development and introduction of new methods for analysing seed quality and vigour of sunflower seed is one of the most important strategies for evaluating genotypes and identifying their biological and productivity characteristics, and for improving their stability under different moisture and temperature conditions. Selecting the right hybrid is the most important management decision of the whole set taken by farmers.

It is possible to conclude that the use of the vermiculite substrate and the temperature of 25°C are adequate conditions for evaluation of sunflower seed germination.

The difference in germination of sunflower hybrids might be due to their genetic potential. Both the standard germination and accelerated aging test are good "tools" for farmers and seed companies to use when assessing early planting and seed vigor, respectively.

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