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## IMPACT OF ENVIRONMENT TEMPERATURE AND STRATIFICATION ON THE *CITRUS AURANTIUM* SEED GERMINATION

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**Abstract:** This study is aimed at investigating the impact of the environment temperature and stratification on the *Citrus aurantium* seed germination. The results show that the optimum environment temperature for the seed germination is found to be 25°C with the maximum percentage of 90%. The stratification of seeds leads to the seed germination percentage decrease by 69% and germination speed increase by 7 days.

**Key words:** *Citrus aurantium* seeds, environment temperature, stratification, germination percentage, seed germinator.

**Introduction.** Citrus trees are grown in a wide climatic range between the latitudes of 40 degrees north and south of the equator. The main commercial citrus production areas appear to be tropical areas above 20 degrees north to south [1]. *Citrus aurantium* (bitter orange) is one of the most common ancestries in Syria and the Mediterranean basin in general. It is characterized by its high resistance to diseases, tolerance to heavy soils and its good compatibility with most species grafted on it. The seeds of this plant contain multiple embryos [2].

Germination is defined as the emergence of seedlings from seed and the initiation of a variety of anabolic activities, including respiration, protein synthesis and the movement of stored nutrients after water consumption [3].

Optimum environment temperature is defined as the environment temperature, at which the maximum germination occurs. Some studies have shown that the optimum environment temperature for seed germination was found to be 28°C for *Citrus macroptera* and *Citrus latipes*, while the optimum environment temperature for *Citrus Indica* seed germination was found to be 26°C [2]. Some studies have shown that the germination speed of three-leafed orange seeds is increased if they are stored at the low temperature of 5°C, compared with the immediate planting after harvesting the fruits [4].

Stratification is defined as the process of seeds experiencing low and constant temperatures to break the secondary dormancy of the seeds and simulate their germination. Some studies have shown that the stratification of Duncan and Hameln

seeds at 4°C for seven days leads to a decrease in the percentage of seed germination [5].

**Research purpose.** The main aim of this research is to investigate the impact of the environment temperature and stratification on the *Citrus aurantium* seed germination.

**Materials and method.** The experiment was carried out in the seed germination laboratory of the Faculty of Agriculture at Tishreen University in Latakia, Syria.

Seeds of the studied *Citrus aurantium* were collected in Latakia, Syria. This area is characterized by the influence of the Mediterranean-type climate. The seeds were immediately extracted from the fruits in order to maintain their high ability to germinate.

The impact of the environment temperature on the seed germination was studied during three months (February, March and April) as follows. Each 10 seeds were placed in a sterile Petri dish with two filter papers saturated by 10 ml of distilled water. 16 Petri dishes (each Petri dish contained 10 seeds) were placed in a seed germinator at the temperature of 10°C. Other 16 Petri dishes were placed in the surrounding environment at the temperature of 13°C to 21°C. Other 16 Petri dishes were placed in another seed germinator at the temperature of 25°C, as shown in Figure 1. This experiment was made in dark conditions in order to avoid the impact of light on seed germination responses.



**Figure 1. *Citrus aurantium* seed germination inside a seed germinator at 25°C.**

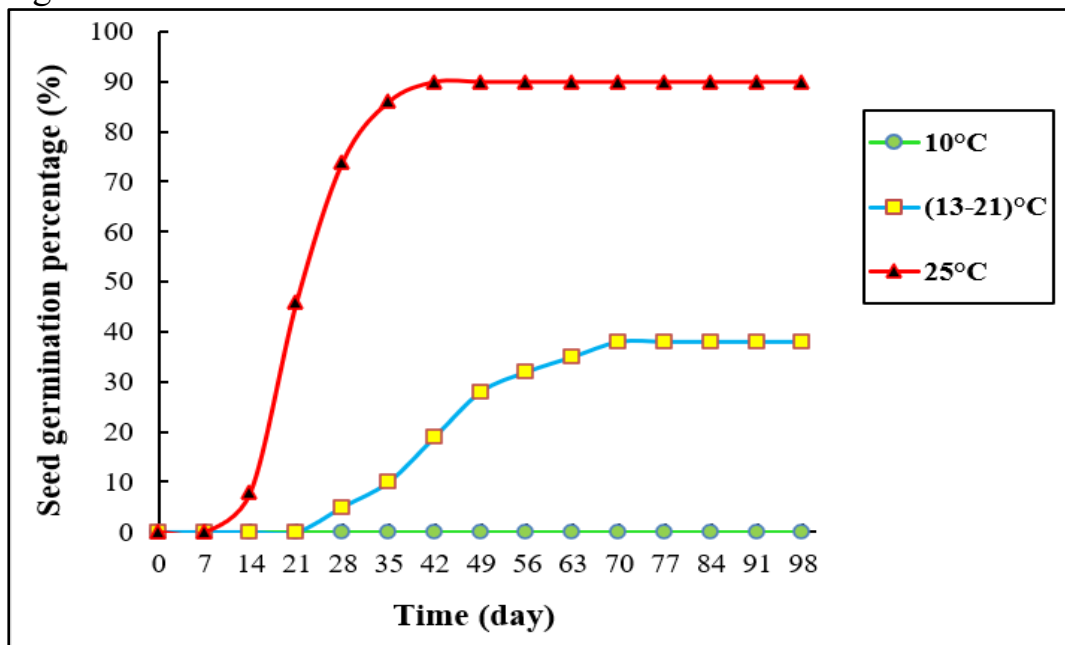
Germination readings were recorded weekly. The germination rate was estimated by calculating the number of seeds germinated per week. The germination percentage was calculated by the formula:

$$GP = \frac{A}{B} * 100 \dots \dots \dots (1),$$

where GP- germination percentage (%), A- number of germinated seeds and B- total number of seeds.

The impact of the stratification on the *Citrus aurantium* seed germination was investigated as follows. Firstly, the seeds were stored at 4°C for 15 days in the dark. Then they were placed in 16 Petri dishes (each Petri dish contained 10 seeds) in a seed germinator at 25°C in the dark during three months (February, March and April). However, the non-stratified seeds (control seeds) were placed in 16 Petri dishes in a seed germinator at the same temperature (25°C) in the dark during three months (February, March and April). This experiment was made in the dark to avoid the impact of light on the seed germination responses.

**Results and discussion.** The curves of relations between the seed germination percentage and the time at different environment temperatures of 10°C, 13-21 °C and 25°C are shown in Figure 2 to demonstrate the impact of environment temperature on the seed germination.



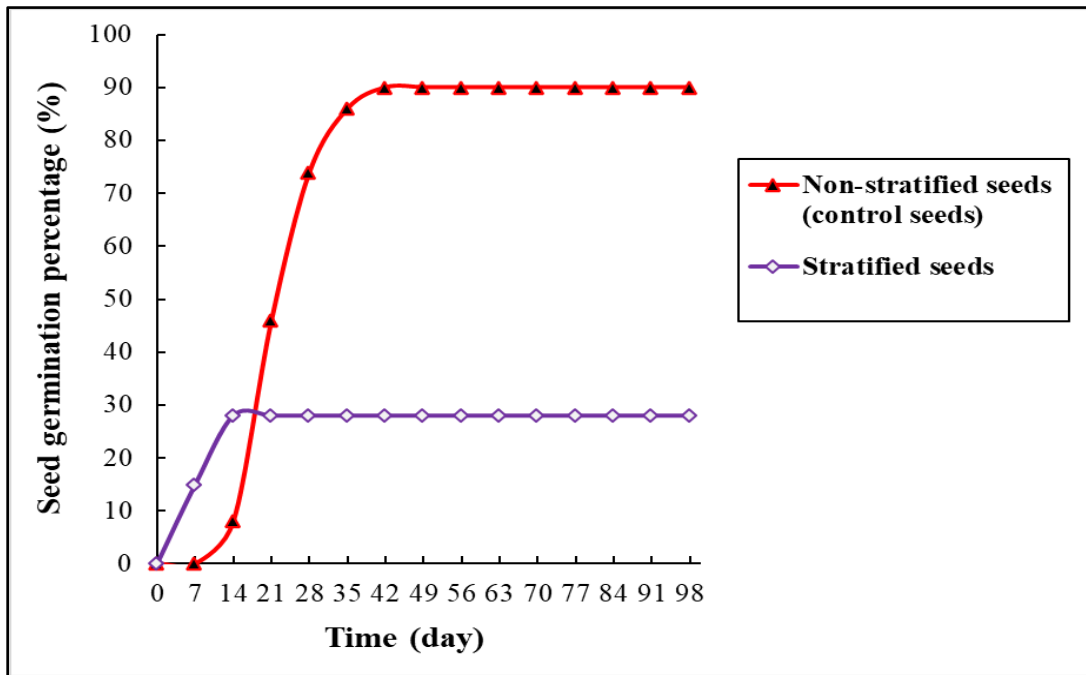
**Figure 2. Curves of relations between the germination percentage and time at 10°C, 13-21 °C and 25°C.**

As shown in Figure 2, it is noticed that, at the environment temperature of 10°C, the seed germination did not occur at all.

However, at the environment temperature of 13-21 °C, it is noticed that the first germination percentage reading was with the value of 5% on the 28<sup>th</sup> day. It is also noticed that the seed germination stopped on the 70<sup>th</sup> day with the maximum percentage of 38%.

At the environment temperature of 25°C, it is noticed that the first germination percentage reading was with a value of 8% on the 14<sup>th</sup> day. It is also noticed that the seed germination stopped on the 42<sup>th</sup> day with the maximum percentage of 90%.

The curves of relations between the seed germination percentage and time for the stratified and non-stratified seeds (control) at 25°C are shown in Figure 3 to demonstrate the impact of stratification on the seed germination.



**Figure 3. Curves of relations between the seed germination percentage and time for the stratified and non-stratified seeds (control) at 25°C.**

As shown in Figure 3, for the non-stratified seeds, it is noticed that the first germination percentage reading was with the value of 8% on the 14th day. It is also noticed that the germination of these seeds stopped on the 42th day with the maximum percentage of 90%.

For the stratified seeds, it is noticed that the first germination percentage reading was with the value of 15% on the 7th day. It is also noticed that the germination of these seeds stopped on the 21th day with the maximum percentage of 28%.

It is worth mentioning that the seed stratification decreases the germination percentage. That is because the rate of the fungal diseases is high in the case of seed stratification.

### Conclusion and recommendations

The following conclusions were made from this study:

1. The optimum environment temperature for the seed germination of *Citrus aurantium* is found to be 25°C with the maximum germination percentage of 90%.
2. The seed stratification at the temperature of 4°C for 15 days leads to the decrease in the maximum germination percentage of seeds by 69% and the germination speed increase by 7 days.
3. It is necessary to treat *Citrus aurantium* seeds with fungicides before planting in order to reduce the fungal infections which decrease the germination percentage.

4. For future research, it is recommended to investigate the impact of other factors on the *Citrus aurantium* seed germination, such as light, seed size, removal of seed coat and use of some chemicals.

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