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DORMANCY BREAKING OF *ACER* AND *FRAXINUS* SEEDS - A BRIEF REVIEW

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Abstract: *This paper describes the most important methods of seed dormancy breaking based on existing literature for Acer and Fraxinus genera. Such methods are important for shortening seed germination. Seeds of many species from these two genera are released from dormant state when they are kept at relatively high humidity and generally low temperature; however more detailed investigations of the seed dormant state are needed, in order to recommend optimum pretreatments before sowing for each species.*

Key words: *Acer, Fraxinus, dormancy, pretreatment, seed.*

1. Introduction

Many forest species have seeds which present a dormant state when fruits are ripe and released from plant. This is a vital mechanism that connects generations of trees and several types of seed dormancy have been recognized. The forms of plant life, regeneration strategies and in particular the environmental conditions, can all influence the types of dormancy.

In order to break the dormancy state and shorten the germination, various treatments of different temperature and humidity regimes are applied to seeds (Figure 1).

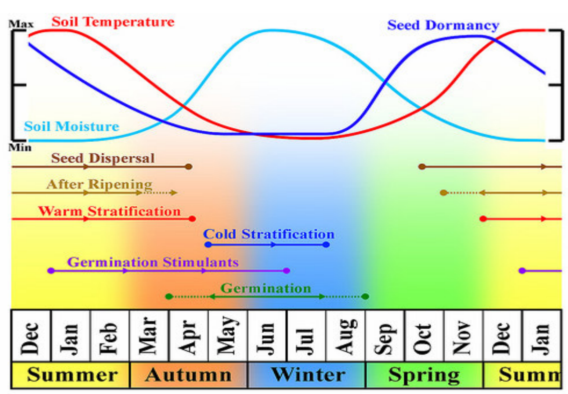

Fig. 1. *Dormancy variation and germination for seed dispersed in a Mediterranean environment* [9]

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In order to stimulate seed germination, the dormancy breaking (pretreatment) methods recommended by the International Seed Testing Association (ISTA) are easily applicable mainly for small batches of seeds; however, in the case of large quantities, ensuring the proper climatic conditions for dormancy breaking might be practically difficult.

Pretreatment methods for seed dormancy breaking have been developed in the last decades for many tree species worldwide. Despite this, there have been only few researches in Romania on such pretreatments for the main forest species.

The aim of this paper is to summarize the existing information on seed dormancy breaking for *Acer* and *Fraxinus* genera, having in mind their importance for the Romanian silviculture, especially in the new afforestation funding context.

2. Seed Dormancy Types

There are many classification systems of seed dormancy. Baskin and Baskin [1], [2] classify the dormant state into five groups:

Physiological: Germination is prevented by mechanism within the seeds embryo or layers which are covering the embryo. Seeds with physiological dormant state (*Liliaceae, Papaveraceae, Ranunculaceae*) normally respond positively to a period of wet storage in different conditions (warm or cold) before sowing at optimum germination temperature.

Morphological: It refers to the seed embryo that is underdeveloped or poorly formed when seeds are released. The embryo continues to grow after dispersal and its germination is prevented until the embryo reaches a critical length specific to the species. Examples can be: *Apiaceae, Orchidaceae, Ranunculaceae.*

Morpho-physiological: Seeds with embryo that appears underdeveloped and with a physiological dormant state. The embryo must grow to a critical size specific to the species and the physiological dormant state of the embryo must be stopped before germination occurs. Examples can be: *Apiaceae, Liliaceae, Magnoliaceae.*

Physical: Due to the cover of fruit and seed with hard water permeability. It may well be, due to the presence of woody walls of fruits or seeds. Examples in the *Anacardiaceae, Fabaceae, Geraniaceae*.

Combined: Appears in seeds which presents physiological dormant state of the embryo and a waterproof cover of the fruit or seed. It refers to a combination of the dormant states. Examples in: *Rhamnaceae, Tiliaceae, Anacardiaceae.*

3. Interruption of the Dormant State of Seeds: *Acer* and *Fraxinus* Genera Examples

Seeds of many tree species are released from dormant state when they are kept at relatively high humidity and generally low temperatures (from 1.5 °C to 15 °C). After dormancy removal, proper germination can usually take place at higher temperatures. This artificial overcoming of seed dormancy by placing it under generally cool and moist conditions (sand, peat etc.) for a period of time is called stratification.

Application of some growth stimulators (micro-nutrients) and ionizing radiation of seeds were also used to interrupt the dormant state and stimulate seed germination [6].

The treatment of *Acer* and *Fraxinus* seeds with gibberellinic acid solution had a positive result on dormancy breaking when applied at the same time with cold stratification; however the treatment of seeds with such a stimulator as a substitute of stratification remained without positive results [5].

Gibberellin application to manna ash seeds led to activation of germination. By treating the seeds with gibberellinic aqueous solutions of 100% concentration 83% germination was recorded, while with distilled water the germination rate did not exceed 2%. The germination period of ash seeds after 90 days warm stratification was significantly reduced from more than 60 days to about 30 days by gibberellins application [7].

Cold treatment is efficient in removing many types of seed dormancy. The embryonic dormant state which is present in seeds of *Acer platanoides*, can be removed after seed storage at high temperature, leaving only the dormant state imposed by seed coat. This is removed by further keeping the seeds at low temperatures. Seeds of other species, such as *Acer negundo* and *Acer pseudoplatanus*, shortly after maturity present a dormant state impose by coat, which can be removed by keeping them at low temperatures [3], [10].

Recent studies [8], demonstrated that seed dormancy of *Acer platanoides* could be broken if seeds were kept a period of time at a relatively constant humidity of 36% and a temperature of 0-1 ºC. The increase of temperature to 5-7 ºC delayed the dormancy removal and a 15-18 ºC temperature induced the secondary dormancy in seeds.

For the seeds of *Acer campestre* the dormant state was associated with the pericarp impermeability. Their dormancy can be removed if stratified for a month in warm condition (12 ºC - optimum temperature), followed by 6-7 months of cold stratification, depending on the origin of seeds [4].

The differences in dormancy depth are reflected by the different durations of refrigeration. For many *Fraxinus* species, a period of warm stratification is needed to develop the immature embryo before cold stratification is applied for dormancy removal. The optimum temperature for *Fraxinus* sp. during the warm stratification period (1-3 months) in 20 ºC, whilst 1-7 ºC is the most common range for the further cold stratification (4-6 months).

This type of pretreatment, consisting of a warm stratification period of seeds followed by a cold stratification period was also applied by Piotto [12] to the seeds of *Fraxinus angustifolia.* He also conducted germination tests in the dark, under two different temperature regimes. The first method was the one prescribed by ISTA [13], by storing the seeds for 8 hours at 30 ºC and 16 hours at 26 ºC. A higher percentage of germination was obtained by applying a second method, keeping the seeds for 8 hours at 25 ºC and 16 hours at 5 ºC [11]. It seems that his low temperature has an effect on the stratified seeds, only when the embryo imbibition is complete.

The length of the cold period (refrigeration) treatment is not necessarily the same for all seeds of the same species, and the dormancy interruption period may vary depending on seed source/provenance and crop year. The seeds of *Fraxinus excelsior* from areas with cold winters need a longer period to break the dormant state comparing to seeds from areas with a milder climate [6]. The stratification period also varies in *Fraxinus ornus* seeds, depending on the origin [11].

Cold stratification requirement of seeds is an adaptation of species to climatic condition in which they grow. When cold treatment is interrupted by a period of higher temperatures, a secondary dormancy can be induced. This phenomenon occurs naturally quite frequently in temperate climates, when short periods of higher positive temperatures could interrupt the typical cold winter.

Optimal refrigeration temperature range has been established for some species; however more detailed investigations of the seed dormant state for *Acer* and *Fraxinus* genera are needed, in order to recommend optimum pretreatments before sowing for each species.

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