Indian J. Applied & Pure Bio. Vol. 32(1), 77-81 (2017).

Effect of Mechanical Scarification and Acid Scarification (H_2SO_4) on the Germination of *Malus domestica* Borkh.

Mudasir Qadir and Fatima Khan*

Department of Botany, Government Science & Commerce College,
Benazeer Bhopal-462013 (India)

Abstract

In the present investigation, seeds of *Malus domestica* Borkh. were subjected to mechanical scarification and acid scarification to achieve early germination by breaking dormancy.

It was found that, on 7th day of sowing, 0% germination was achieved in case of seeds kept as control and H_2SO_4 treated seeds, whereas it was 90% in the seeds treated with mechanical scarification**.** Hence, it is inferred that *Malus domestica* seeds, before sowing should be treated with mechanical scarification (making cuts on the seed coats by knives or scissors) so as to achieve the early germination but it is important that the cut should be made carefully in the seeds so that may not damage the delicate embryonic tissues.

In nature, the seeds of some plants easily germinate after sowing but the seeds of a number of plants do not germinate easily and exhibit dormancy for varying period of time. The dormancy may be due to internal factors such as; impermeability of seed coats to moisture and oxygen, immaturity of the embryo, dominance of germinating inhibitors in seeds and testa barrier, and due to external factors such as; unavailability of water, unavailability of oxygen, inappropriate temperature, and in some seeds due to unavailability of light. Certain plants may immediately germinate after the harvest, it can be best exemplified by the seeds of *Pisum sativum*, which sometimes germinate in the fruit itself which is still on the plant, a phenomenon known as vivipary. However, sometimes the dormancy period is very prolonged and can take months together for germination. This is true for the seeds of *Malus domestica* Borkh. which has a hard seed coat and *Entada gigas* which has a very thick seed coat and do not germinate easily.

In the present study, seeds of *Malus domestica* were tested for their germination potential and shortening of dormancy period. Initial studies showed that the seeds are dormant and there is no germination even after one weak of sowing. Therefore, it was thought imperative to undertake this investigation to find out the substance that can break the dormancy of *Malus domestica* seeds. The seeds were subjected to acid scarification

*Present address : Govt. College, Nasrullah Ganj M.P. (India).

(H_2SO_4) and mechanical scarification (by making cuts on the seed coats by knives). The best treatment among these was found to be mechanical scarification (by making cuts on the seed coats by knives).

According to Berlyn[2], germination is a sequential series of morphogenetic events that result in the transformation of an embryo into a seedling. The seeds of every plant have the capability to germinate but their germination is affected due to some factors, such as seed coat, hard seed coat, rudiment embryo, over-ripening, presence of plant growth inhibitors, due to absence of water, oxygen and due to unfavourable conditions.

Dormancy of seeds is due to external factors or due to internal factors. When it is caused due to internal factors, it is called as true dormancy or innate dormancy or primary dormancy. And when it is caused due to external factors, it is called as imposed dormancy or quiescent dormancy or secondary dormancy. Both of these primary and secondary dormancy influences are mutually dependent and can not be singled out. True dormant seeds do not germinate even if they are provided with suitable environmental factors. Secondary dormant seeds may germinate immediately after shed off. After some storage, they fail to germinate and thus exhibit secondary dormancy. Some seeds such as *Brassica alba, Ambrosia tripolia* and *Xanthium pennsylvanicum* exhibit secondary dormancy. Secondary dormancy is opposite to after ripening. Presence of high carbondioxide concentration, absence of light and very high or low temperature induce the secondary dormancy.

A number of techniques are available for breaking the dormancy of seeds, such as; scarification, exposure to light, alternating high & low temperatures, stratification, impaction, pressure, electric current, pretreatment with coumarins, kinetin, GA_3, H_2SO_4, thiourea, KNO_3 and hot water.

Studies on germination and dormancy of seeds have been carried out by various workers on different types of species. These include; the studies of Asha, and Illa,[1] on the effect of seed direction and growth media on *in vitro* seed germinarion and seedling establishment of *Pterocarpus marsupium*. Bewley and Black[3] studied the physiology and biochemistry of seeds. Seed germination and dormancy have been studied by Bewley,[4]. Cantoro, *et al.,*[5] have reported seed dormancy QTL identification across a *Sorghum bicolor* segregating population.

Chouard[6] has investigated vernalization and its relation to dormancy. Influence of low temperature in improving germination percentage was found out by Conville, (1920). Dave, *et al.*,[7] have investigated the Regulation of *Arabidopsis thaliana* seed dormancy and germination by 12-oxo-phytodienoic acid. *Entada phaseoloids* seed dormancy and germination: implications for conservation and restoration has been reported by Deepa, and Shinde,[7,8]. The effect of the use of temperature on the breakage of dormancy and the subsequent performance of rice (*Oryza* spp.) has been investigated by Doku *et al.,*[9].

Experimental induction of dormancy in *Betula pubescens* was investigated by Eagles & Wareing[10]. Evanari,[11] has studied the physiology of seed dormancy after ripening and germination. Similarly, alternating temperatures to break the dormancy was used by Harrington[12]. Hayes & Klein,[13] investigated special quality influence of light during development of *Arabidopsis thaliana* plants in regulating seed germination. Trans-criptome analysis of seed dormancy after rinsing and chilling in ornamental peaches (*Prunus persica*) has been investigated by Kanjana, *et al.,*[14]. Effect of pre-sowing treatment on seed germination of Babchi *(P. corylifolia)* and Senna *(Cassia angustifolia)* in nursery has been reported by Koppad, and Umarbhadsha,[14].

Ribosome and enzyme changes during maturation and germination of the castor bean seeds was investigated by Marre[16]. Effect of different pretreatments and seed coat on dormancy and germination of seeds of *Senna obustifolia* has been studied by Mensah, and Ekeke[17]. Mishra[18] has investigated the effect of temperature and light on the seed germination of *Sida cordifolia.* Musara, *et al.,*[19] have investigated the evaluation of different seed dormancy breaking techniques on Okra *(Abelmoschus esculentus* L.*)* seed germination. The release of dormancy, a wake-up call for seeds to germinate has reported by Nee, *et al.,*[20]. Isoenzymes of sugar phosphate metabolism in endosperm of germinating castor beans were studied by Nishimura[21]. Redwood, *et al.,*[22] have reported seed longevity and dormancy state in a disturbance-dependent forest herb, *Ageratina altissima.*

Siva, *et al.,*[23] have studied the enhanced seed germination of *P. corylifolia* L. by heat treatment. Germination pretreatments to break hard-seed dormancy in *Astragalus cicer* L. has been studied by Statwick[24]. Effects of light, temperature and their interaction on the germination of seeds was investigated by Toole[25]. Effect of various dormancy breaking treatments on seed germination, seedling growth and seed vigour of medicinal plants has investigated by Warghat, *et al.,*[26] and Zohra, *et al.,*[27] have reported the effect of salicylic acid on germination of *Ocimum gratissimum* seeds induced into dormancy by chlormequat.

Healthy seeds of *Malus domestica* were collected from Ferozpora Sopore (Kashmir). The seeds were surface sterilized with 0.1% H_gCl_2 solution for 5 minutes to kill or to remove the surface adhering microbes. Uniform sized seeds were then transferred to sterilized Petri Plates provided with filter paper pads.

Three replicates of treated and control were kept for their germination studies. The filter paper pads were moistened as and when needed. The emergence of radicle was taken as germination.

Germination started from 3rd day onwards. The germination percentage was 0% (control), 0% (H_2SO_4 treated seeds) and 40% (mechanical scarification treated seeds). On the 5th day, it was 0% (control), 0% (H_2SO_4 treated seeds) and 70% (mechanical scarification treated seeds) and finally on 7th day, the germination percentage was recorded as 0% (control), 0% (H_2SO_4 treated seeds) and 90% in mechanical scarification treated seeds. The results are shown below in table-1.

Table-1. Showing the effect of Mechanical Scarification and Acid Scarification on the germination of *Malus domestica*

D A S	3rd Day	5th Day	7th Day
Control	0%	0%	0%
Acid Scarification (H_2SO_4)	0%	0%	0%
Mechanical Scarification	40%	70%	90%

A perusal of table-1 indicates that pre-treatment of *Malus domestica* seeds with mechanical scarification improved the germination percentage compared to the seeds which were treated with H_2SO_4 and those which were kept as control. On the 3rd day, the germination percentage was recorded as 0%, 0% and 40%. On the 5th day, the germination percentage was recorded as 0%, 0% and 70% and finally on 7th day, the germination percentage was recorded as 0% (control), 0% (H_2SO_4 treated seeds) and 90% (mechanical scarification treated seeds). The results found indicate that the seeds of *Malus domestica* undergo the period of dormancy due to hard seed coat. The seed coat of *Malus domestica* prevents water and oxygen to enter into the seed due to which the seed follows a dormancy period. The studies on *Malus domestica* have carried out by various workers and they found that the seeds of this plant need a period of chilling which is called as after ripening for about three months in which the seed remains dormant and after this period, the seeds start germinating in nature. But the present investigation indicates that there is a big role of seed coat for dormancy in the seeds of *Malus domestica* which decays due to micro-organisms and moisture during this period of dormancy. So the dormancy of *Malus domestica* seeds may be due to a hard seed coat which is not permeable to water and oxygen during the period of dormancy.

In the present investigation, it was found that the pre-treatment by mechanical scarification (making cuts on the seed coats by knives) supported the highest germination percentage. Hence, it is inferred that *Malus domestica* seeds, before sowing should be treated with mechanical scarification (making cuts on the seed coats by knives) so as to achieve the early germination but it is important that the cut should be made carefully in the seeds so that may not damage the delicate embryonic tissues.

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