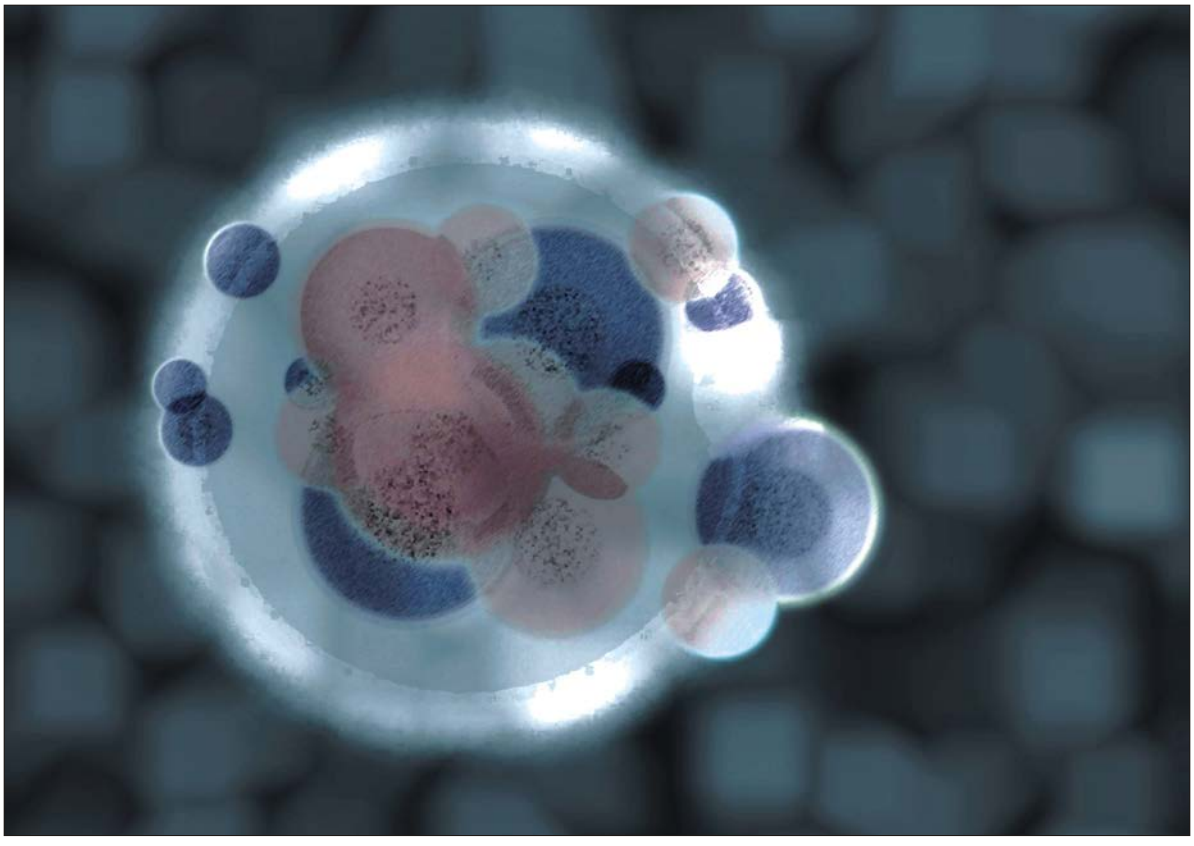

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# Effects of Seed Scarification on Seed Germination and Early Growth of Olive Seedlings

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**Abstract:** Present study conducted to evaluate the effects of chemical and mechanical scarification treatments on percentage and rate of seed germination of olive cultivars (Arbequina and Koronaiki). Results indicated that chemical and mechanical scarification treatments followed by an adequate stratification period can increase seed germination significantly. The best results obtained by chemical scarification treatments and mechanical scarification were not as effective. Chemical scarification treatments removed seed surrounding structure more uniform. The least germination rate and percentage was observed in control treatments. The highest germination percentage of cv. Koronaiki obtained after 97% sulfuric acid solution treatments for 6 h (up to 73%). Treating seeds of this cultivar by 97% sulfuric acid for longer period resulted in damage to embryo and no seedlings emerged after these treatments. The best result for cv. Arbequina observed following 97% sulfuric acid treatment for 9 h (69.5%). Mechanical treatment had no effect on germination percentage or germination rate of seeds of this cultivar. Growth of olive seedlings also increased by scarification treatments significantly. Results suggested that chemical and mechanical scarification treatments can improve germination percentage and seedling growth of olive cultivars.

**Key words:** Early growth, olive, mechanical scarification, acid scarification, seed germination

## INTRODUCTION

Commercial olives belong to the species *Olea europaea* L. of oleaceae family. Olive is one of the most important commercial fruit trees grown in regions with Mediterranean climates. Olives are originated from Mediterranean Sea basin and its cultivation has been started from ancient times (Zohary and Spiegel-Roy, 1975; Liphschitz *et al*., 1991).

Olives can be propagated by seed, cutting, grafting and sucker; but the most common method is the rooting of stem cuttings under mist system. Stem cuttings of selected cultivars are hard to root, even after application of 3000 mg $L^{-1}$ IBA solutions. The efficiency of propagation is low and the root systems of the rooted cuttings are also shallow, spreading to 0.9 or 1.2 m even in deep soils. Growing seedlings and grafting the selected cultivars on them may be a suitable alternative for olive propagation.

Germination of olive seeds is difficult and the rate and the final percentage of germination are low; e.g., germination of some cultivars may last more than three years (Sotomayor-Leon and Cabalero, 1990). Hard endocarp layer of fruits surrounding the olive seeds act as a physical barrier and limits the diffusion of water and gases into the seeds. The hard coverings of olive seeds also may act as mechanical obstacle of development and germination of the embryos (Sotomayor-Leon and Cabalero, 1990). Moreover, it has been shown that endocarp and seed coat of olive seeds may contain chemicals preventing germination of seeds (Orinos and Mitrakos, 1991). Lagarda *et al.* (1983a) and Voyiatzis and Porlingis (1987) reported that the germination of olive seeds is limited, even after removing hard seed coverings. Voyiatzis and Pratisa (1994) concluded structures surrounding olive seed may contain factors limiting development of embryos, after observing low and erratic germination of scarified seeds.

The olives cultivars Koronaiki and Arbequina are of the most important seed producing cultivars, which may be used as rootstock of other olive cultivars. Arbequina is a high yield and early bearing cultivar which is tolerant to cold, drought and salinity. Koronaiki is also a high yield cultivar which is tolerant to high temperatures. The both cultivars are graft-compatible and may use as rootstock for selected commercial olive cultivars. Objectives of the current study were to evaluate the effectiveness of chemical and mechanical scarification treatments beside stratification of seeds on seed germination and early growth of olives Arbequina and Koronaiki seedlings.

## MATERIALS AND METHODS

The study was conducted at the physiology laboratory of the Department of Horticultural Science of Shiraz University from summer 2008 to spring 2009.

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**Plant materials:** Fruits of Arbequina and Koronaiki brought from Kazerun olive research station, located at Kazerun, Iran. The fruits were at yellow stage (Lagarda *et al*., 1983a, b). After extraction of seeds, they soaked in 2% NaOH solution for 30 min to eliminate the oils (Lagarda *et al*., 1983a). Extracted seeds soaked in water and empty seeds removed. Washed seeds air dried and stored at dry and cold condition.

**Chemical scarification:** Olive seeds soaked in sulphuric acid 97% for 0, 3, 6 and 9 h at 25°C. Seeds and acid solution mixed at 1:2 ratio. The mixtures had been agitated during treatment periods to prevent accumulation of dark resin compounds (Hartmann *et al*., 2001).

**Mechanical scarification:** Mechanical scarification treatments applied by ForsBERGLINE-Forsbergs, Inc. The apparatus consist of two cylinders, which the body of inner cylinder is rough and movement of seeds between the cylinders leads to mechanical scarification of hard endocarp. Mechanical scarification treatment was carried out by spinning the handle of the instrument, till the hard endocarps became thin and shiny, but not pierced (Hartmann *et al*., 2001).

Seeds placed in running tap water for 12 h and then surface sterilized by 10% Clorox for 15 min, after scarification treatments.

**Cold stratification:** Surface sterilized seeds mixed with coco peath in 1:3 ratio. The mixture placed in pitted plastic bags and incubated at 15°C for 1500 h (Lagarda *et al*., 1983a; Voyiatzis and Porlingis, 1987). After stratification period, seeds washed and sowed in plastic bags (20×25 cm) containing a mixture of sand, soil and peat (1:1:1 ratio). Seeds placed in 2 cm depth of the media uniformly (one seed per pot). The bags placed under mist system in the research greenhouse of the Department of Horticultural Science of Shiraz University at 25±3/15±3 (°C), day/night temperature for 65 days. Germination of seeds recorded at 2 days intervals. At the end of experiment, percentage of seed germination, cumulative seed germination and length of roots, height of shoots and number of leaves per seedling reported.

**Statistical analyses:** The experiment arranged as complete randomized design with 5 scarification treatments, 5 replications and 40 bags per replication. Data analyzed by SPSS v 16.0 (SPSS Inc.) for Windows software. Means separated by Tukey's HSD test at $p \leq 0.05$.

## RESULTS

The results showed that mechanical and chemical scarification treatments increase olive cultivars seed germination to their respective controls significantly. Seed germination of different cultivars was not similar; olive seeds also responded better to the chemical treatments and the best results obtained in Koronaiki. Sulphuric acid for different periods of time solved the hard endocarp of Koronaiki fruits. However, no seed germinated in 9 h treatment because of severe damage to the endocarp and penetration of the acid into the seeds. The best germination observed in 6 h acid treatment (73%); however no significant differences observed between 3 and 6 h acid treatments (Table 1).

Table 1: Effects of mechanical and chemical scarification treatments on seed germination and early growth of Koronaiki

| Treatments | Germination (%) | Root length (cm) | Stem height (cm) | Leaf No. |
|---|---|---|---|---|
| Control | 11.5c† | 4.8d | 3.04d | 0.6d |
| Mechanical | 55.0b | 6.4c | 4.22c | 2.0c |
| $H_2SO_4$ – 3 h | 64.0ab | 9.5b | 6.25b | 2.4b |
| $H_2SO_4$ – 6 h | 73.0a | 11.6a | 7.90a | 5.2a |
| $H_2SO_4$ – 9 h | 0.0d | 0.0e | 0.00e | 0.0d |

†Columns with the same letter(s) were not significantly different according to Tukey's test at $p \leq 0.05$

Table 2: Effects of mechanical and chemical scarification treatments on seed germination and early growth of Arbequina

| Treatments | Germination (%) | Root length (cm) | Stem height (cm) | Leaf No. |
|---|---|---|---|---|
| Control | 5.5d† | 3.0c | 1.9c | 0.2b |
| Mechanical | 5.5d | 4.3bc | 2.8bc | 1.1b |
| $H_2SO_4$ – 3 h | 3.4c | 6.4ab | 4.2ab | 1.2b |
| $H_2SO_4$ – 6 h | 58.0b | 7.6a | 4.9a | 3.0a |
| $H_2SO_4$ – 9 h | 69.5a | 8.8a | 5.6a | 3.4a |

†Columns with the same letter(s) were not significantly different according to Tukey's test at $p \leq 0.05$

Sulphuric acid treatments for 3, 6 and 9 h were effective in solving the hard endocarp of Arbequina and seed germination increased significantly to the respective control. The best germination percentage obtained in 9 h acid treatment (69.5%) for this cultivar (Table 2).

Mechanical scarification by ForsBERGLINE was effective in attenuating the hard endocarp surrounding the seeds of Koronaiki (Table 1) and resulted in a significant increase in seed germination (55.0%). However, seed germination of Arbequina did not affected by mechanical treatment (5.5%) and no difference observed to the control treatment (Table 2).

Scarification treatments also increased the rate of seed germination of both cultivars significantly (Fig. 1a, b). However, in the case of Arbequina, the rate of seed germination did not affected by mechanical scarification treatment (Fig. 1a).

Early growth of olive cultivars seedlings also increased by scarification treatments significantly to the respective controls (Table 1, 2). Growth indexes of olive seedlings were higher in the sulphuric acid treatments. The best results obtained at 6 and 9 h of the acid

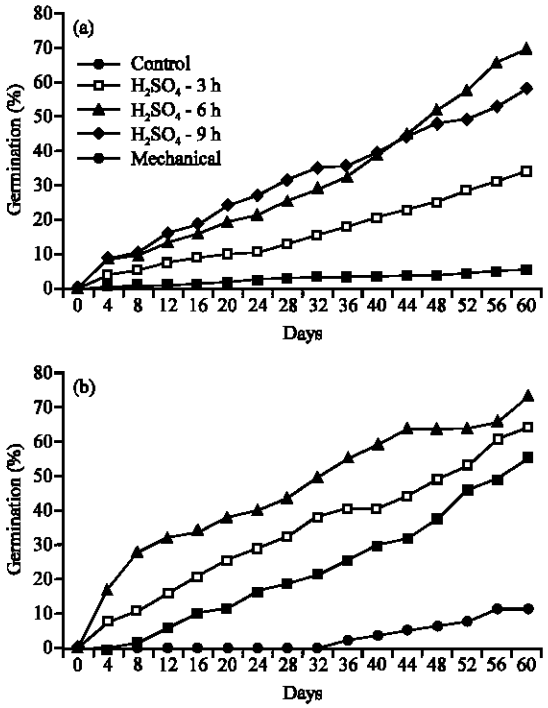


Fig. 1: Effects of mechanical and chemical scarification treatments on germination rate of olive cultivars (a) Cultivar Arbequina and (b) Cultivar Koronaiki. Control and mechanical scarification treatments are equal in Arbequina. Sulphuric acid treatment for 9 h acid treatment of Koronaiki, did not germinate

treatments for Koronaiki and Arbequina, respectively. Generally, Koronaiki growth indexes were higher than Arbequina after the scarification treatments.

## DISCUSSION

In the current study, the effects of chemical and mechanical scarification treatments were investigated on seed germination and early growth of two olive cultivars. The results showed that used treatments increase the rate and the percentage of germination and early growth of olive cultivars seedlings significantly.

Endocarp layer of olive fruits surrounding the seeds is a compact hard woody structure preventing penetration of moisture and gases into the seed and inhibits development of embryo (Orinos and Mitrakos, 1991). Breakdown of this layer by mechanical stresses or chemical reactions leads to penetration of water and activation of embryos. In the current study, increase in seed germination of olive seeds following scarification treatments is due to softening and increase in permeability of the endocarp layer. Lagarda *et al.* (1983a) reported that olive seeds require moist stratification period for optimum germination. Voyiatzis and Porlingis (1987) stated that this phenomenon may due to presence of some chemical factors preventing embryo development. Stratification of seeds leads to breakdown of such chemicals and improves seed germination (Lagarda *et al.*, 1983a). Seeds need absorption of water and exchange of gases during the stratification period. Seeds scarification treatments attenuate the hard structures surrounding seeds and let more water absorption and gases exchange by seeds and may improve stratification efficiency (Voyiatzis and Porlingis, 1987). Results of this study are in agreement with Orinos and Mitrakos (1991) and Awan *et al.* (2003).

Seed germination and early growth of olive seedlings after Sulphuric acid treatments were much better than the mechanical scarification; e.g., mechanical scarifications did not affect germination and growth of Arbequina seedlings. Bandino *et al.* (1999) also reported that chemical scarification treatments lead to better olive seed germination. The higher efficiency of sulphuric acid treatments may be due to better and more uniform contact of the loosening factor to the hard endocarp layer.

Olive cultivars did not respond to the scarification treatments similarly. The germination and growth data showed that endocarp layer of Koronaiki fruits is thinner than Arbequina and this phenomenon leads to increase the efficiency of the scarification treatments in attenuating of Koronaiki endocarp. The phenomenon also may due to difference in the maturity level of the fruits of these cultivars.

## CONCLUSION

Results of this study showed that olive seed germination and early growth of seedlings may be increased by scarification treatments. Sulphuric acid treatments are more effective in removing hard endocarp surrounding olive seeds than the mechanical scarification. Such practices may be suggested to use in commercial nurseries and also in breeding programs for enhancing the seed germination and early growth of olives. However, the results demonstrated that the maturity level and/or firmness and structure of endocarp layer of different olive cultivars are not similar and the proper time of harvest and/or treatments period should be evaluated for individual cultivars before using the acid scarification treatments.

## REFERENCES

Awan, A.A., A. Iqbal and G. Idris, 2003. The germination of European type olive seed as affected by different sowing methods. Asian J. Plant Sci., 2: 881-882.

Bandino, G., P. Sedda and M. Mulas, 1999. Germination of olive seeds as affected by chemical scarification, hot water dip and gibberellic acid treatments. Acta Hortic., 474: 35-35.

Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greeve, 2001. Principles and Practices of Plant Propagation. 6th Edn., Prentice Hall Publishers, London.

Lagarda, A., G.C. Martin and D.E. Kester, 1983a. Influence of environment, seed tissue and seed maturity on Monzanilo olive seed germination. Hortic. Sci., 18: 868-869.

Lagarda, A., G.C. Martin and V.S. Polite, 1983b. Anatomical and morphological development of Manzanillo olive seed in relation to germination. Anatomical and morphological development of Manzanillo olive seed in relation to germination. J. Am. Soc. Hortic. Sci., 108: 741-743.

Liphschitz, N., R. Gophna, M. Hartman and G. Biger, 1991. The beginning of olive (*Olea europaea* L.) cultivation in the old world: A reassessment. J. Archaeol. Sci., 18: 441-453.

Orinos, T.H. and K. Mitrakos, 1991. Rhizogenesis and somatic embryogenesis in calli from wild olive (*Olea europaea* L.) var. *Sylvestris* (Miller) Lehr, mature zygotic embryos. Plant Cell Tissue Organ Cult., 27: 183-187.

Sotomayor-Leon, E.M. and J.M. Cabalero, 1990. An easy method of breaking olive stones to remove mechanical dormancy. Acta Hortic., 286: 113-116.

Voyiatzis, D.G. and I.C. Porlingis, 1987. Temperature requirements for the germination of olive seeds. J. Hortic. Sci., 62: 405-411.

Voyiatzis, D.G. and T. Pratisa, 1994. The onset and disappearance of relative dormancy of olive embryos as affected by age. Acta Hortic., 356: 148-151.

Zohary, D. and P. Spiegel-Roy, 1975. Beginnings of fruit growing in the old world. Science, 187: 319-327.