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The Effects Of Different Treatments On Carob (*Ceratonia Siliqua* L.) Seed Germination

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Abstract

This study was carried out to determine the effects of different treatments on seed germination on a wild carob genotype grown in Silifke province (Mersin, Turkey). In this study, the seeds were stratified in 2014 year. After the stratification, sulfuric acid and gibberellic acid were applied to the seeds. Experimental design was planned with three replicates, and 30 seeds per each replicate were used. Carob seeds were treated with different diluted sulfuric acid concentrations (Control, 80, 85, 90 and 95%) for 30 minutes in petri dishes, and then were soaked in water for two days. In gibberellic acid treatments, seeds were treated with 500 ppm, 1000 ppm and 1500 ppm concentrations for 24 hours. All treated seeds were sowed to perlite. The results showed that the seeds didn't germinate in control group, the highest germination rate for sulfuric acid treatment was observed in 95 % sulfuric acid as 88,90 %, and the highest germination rate for gibberellic acid treatments was observed in 1000 ppm dose as 28,90 %.

Keywords: Carob, *Ceratonia siliqua*, Seed, Treatment, Germination

Giriş

Turkey is one of the homeland regions of carob (Pekmezci et al., 2008). Various wild carob genotypes have been grown in the Mediterranean and Aegean regions of Turkey (Gübbük et al., 2010).

According to data of the world carob production from the year 2012, Spain with 40000 tons was ranked 1, Italy with 30841 ton ranked 2, Portugal with 23000 tons ranked 3, and Turkey with 14218 tons ranked 6 (Anonymous, 2014a). In 5119 hectares in Turkey in 2013 were produced 14261 tons of carobs (Anonymous, 2014b).

Propagation of carob is a major factor to achieve carob cultivation. Therefore, the studies on modern methods of propagation and nursery management are a very critical subject (Güneş et al., 2009).

Carob rootstocks are raised from open-pollinated seeds and these seedling rootstocks vary widely in vigour, habit and cold resistance. The seedling stocks should be budded 1 year after germination, in the nursery, or 2 years from germination, after planting in the orchard. Vegetative propagation by cuttings is not yet commercially available (Batlle and Tous, 1997).

Ceratonia siliqua seeds are brown, with extremely tough and impermeable seed coats that impede water absorption, thus hindering germination. The particular hard seed coats allows the formation of soil seed banks, the dispersal by large mammals that feed on them as well as the survival after fires (that are very frequent in the areas where this species occurs). Without any pretreatment, the germination percentage rarely exceeds 10% (Piotto et al., 2003).

Carob seeds require scarification with acid or hot water treatment. Germination can be hastened by treating them with tap water, boiling water, sulphuric acid (H_2SO_4) or gibberellic acid (GA_3) (Batlle and Tous, 1997; Güneş, 2009; Güneş et al., 2013; Yıldız, 1995). Mechanical scarification and sulfuric acid treatment were found to be superior in terms of imbibition, germination percentage, average germination time, energy of germination and germination index in carob (Güneş et al., 2013). In addition some other treatments before sowing carob seeds may affect the germination percentage, germination time and seedling growth such as stratifying at 4 ˚C for 80-100 days, at 4 ˚C for 80-100 days in sand, at 4 ˚C for 80-100 days in perlite, soaking in hot water at 40 ˚C for two hours, and soaking in water at 18±2 ˚C for two days. The highest germination percentage (77,80%) was observed in

soaking in hot water at 40 ˚C for two hours (Yaşin and Gübbük, 2005).

This study was carried out to determine the effects of some pre-treatments by sulfuric acid and gibberellic acid on seed germination of a wild carob genotype.

Materıals and Methods

This research has been carried out on selected a genotype, which are from seedling wild carob population as a result of a selection breeding study in Silifke province (Mersin, Turkey) in 2014.

Pods containing mature seeds of carob were harvested from the genotype. Stratified seeds were subjected to following treatments:

- Soaking in 80% H2SO4 for 30 minutes, and then immersing in water for 2 days
- Soaking in 85% H2SO4 for 30 minutes, and then immersing in water for 2 days
- Soaking in 90% H2SO4 for 30 minutes, and then immersing in water for 2 days
- Soaking in 95% H2SO4 for 30 minutes, and then immersing in water for 2 days
- Immersing in 500 ppm GA3 for 24 hours
- Immersing in 1000 ppm GA3 for 24 hours
- Immersing in 1500 ppm GA3 for 24 hours

Seeds were placed in pots with perlite after the treatments. Percentage of germination was determined 10 days after treatments.

Experimental design and statistical analysis: The experimental design was planned according to randomized plots with three replicates. 30 seeds were used for each replicates. The Kolmogorov-Simirnov and Levene's tests were applied to test normality and homogeneity of variance, respectively. Data set was analyzed with one-way ANOVA and means compared with Duncan's multiple range test. Variable was displayed as mean±standard error of the mean (SEM). The alpha level was set at 5%. The statistical analysis was performed using Minitab 17 statistical package program.

Results and Dıscussıon

No statistical differences ($p>0.05$) were observed among the both sulfuric acid and gibberellic acid treatments. Germination was not observed in the control group seeds.

As a result of this study, in the sulfuric acid treatments, the highest germination rate (88,89%) was obtained with the treatment of soaking in 95% H_2SO_4 for 30 minutes, and then immersing in water for 2 days (Table 1 and Figure 1). In the other studies, the best germination rate (96,66%) was obtained in sulphuric acid solution for 45 minutes or soaking in warm water at 40 °C for 180 minutes (Yıldız, 1995); the highest germination rate (93,06%) was obtained with the treatment of 98% H_2SO_4 for 30 minutes, the lowest germination rate was 22,92% in the control treatment followed by 23,61% by soaking the seeds in 60% H_2SO_4 (Güneş, et al., 2009); in seeds soaked in concentrated sulphuric acid (96%) for 1, 2 or 30 min, the final germination percentages were 88, 80 and 86%, respectively (Garcia, 2009); the highest germination rate (over 90%) was observed soaking in pure (98 %) or diluted sulphuric acid (H_2SO_4, 40 %, 90 %) for 30 minutes then kept in water for 2 days or just soaking the seeds in sulfuric acid for 30 minute, the lowest germination rate under both conditions was observed in the control and soaking the seeds in 60 % H_2SO_4 for 30 minutes, and the highest germination rates were recorded after ten days of pre-treatments in both conditions (Gübbük et al., 2012); the lowest germination rate (13,57%) was found in the control, the highest germination percentages were obtained in both the mechanical scarification treatment (a small cut, 1-2 mm in length was made on the individual seed coat opposite the hilum without causing any damage to the cotyledons) as 95,69% and dipping in sulfuric acid (seeds were immersed in 98% sulfuric acid for 20 min at 24°C, then thoroughly washed in running tap water and dried on paper towels) as 93,84%. Nine days after the treatment, there was a significant positive correlation between imbibition and germination percentage (Güneş et al., 2013). Our results are in accordance with those obtained in the literature results, approximately. As in other studies, our study we also observed the lowest germination percentages in control group.

In the gibberellic acid treatments, the highest germination rate (28,89%) was obtained ith the treatment of immersing in 1000 ppm GA_3 for 24 hours (Table 1 and Figure 1). In a literature, seeds were immersed in a gibberellic acid solution (250 mg·L-1 GA3) for 24 h. Soaked seeds did not significantly increase the final germination percentages compared to control seeds (average 25%), varying within the range of 6 to 30% (average 20%), and the gibberellic acid solution applied (250 mg·L-1) was not effective in promoting carob seed germination (Garcia, 2009). In the our study,

germination percentage for gibberellic acid was higher than the literature.

In conclusion the results of this study indicate that the sulphuric acid treatments are considerable, gibberellic acid treatment is not required. In addition, referring economically, treatment of soaking in 85% H_2SO_4 for 30 minutes, and then immersing in water for 2 days may recommended.

Table 1. List of germination percentages observed in treatments with mean values, standard deviation and range

Treatments	Mean±S.D.	Range
80%	62,20±54,30	100,00
85%	87,78±13,47	26,67
90%	86,67±0,00	0,00
95%	88,89±1,92	3,33
500 ppm	17,78±10,18	20,00
1000 ppm	28,89±3,85	6,67
1500 ppm	24,44±13,47	26,67

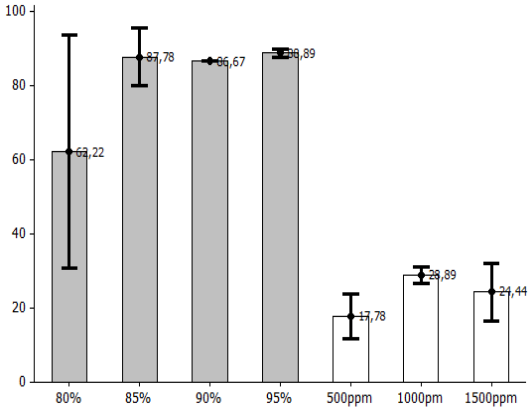

Figure 1. Germination percentages for sulfuric acid (80%, 85%, 90% and 95%) and gibberellic acid (500 ppm, 1000 ppm and 1500 ppm)

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