Effect of Some Pretreatments on Seed Germination of Turkish Hazel (*Corylus colurna* L.)

A. Aygun[1], V. Erdogan[2] and E. Bozkurt[1]
[1] Ordu University, Faculty of Agriculture, Department of Horticulture, 52200 Ordu, Turkey
[2] Ankara University, Faculty of Agriculture, Department of Horticulture, Diskapı, 06110 Ankara, Turkey

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Abstract

Seeds of Turkish hazel take a long time to germinate under natural conditions. However, fast and uniform germination is desirable, especially in breeding studies. In this study, the seeds were either directly planted in the field or the following treatments were applied to the seeds to improve germination: 0, 25, 50, 75, 100, 200 and 400 ppm Gibberellic acid (GA_3), scarification with acid for 2 hours, shell splitting and stratification in moist peat at 4°C for 100, 110 and 120 days. Three replications were used for each treatment. Acid scarification, shell splitting, and 100 and 110 days of stratification did not result in any germination. The field planting and 120 days of stratification resulted in 64% and 14.2% germination, respectively. All of the GA_3 treatments resulted in higher germination than the control (0 ppm). Germination increased as GA_3 concentration increased but higher concentrations had a negative effect on germination; 0, 25, 50, 75, 100, 200 and 400 ppm GA_3 resulted in 41.3%, 67.6%, 92.1%, 100.0%, 84.7%, 56.0% and 61.6% germination, respectively. Germinated seeds were transplanted into peat moss in plastic bags. Transplantation success was the highest (70.6%) in the 25 ppm GA_3 treatment followed by 75 ppm (64.0%).

INTRODUCTION

The Turkish tree hazel (*Corylus colurna* L.) is one of the wild species within the genus *Corylus*. It grows in a tree form and can reach a height of 15-30 m with a trunk diameter up to 1 m (Ansin and Ozkan, 1997; Mitrovic et al., 1997, 2001). It occurs naturally in mixed temperate forests of Romania, the Balkans, northern Turkey, Transcaucasia and northern Iran (Thompson et al., 1996). It originated in Anatolia and was taken to Europe in 1582 (Ayfer et al., 1986). In Turkey, native Turkish tree hazel stands can be found in several provinces in the Black Sea region but it is especially concentrated around the Bolu district (Ayfer et al., 1986; Ansin and Ozkan, 1997).

The trees are used as an ornamental plant in parks and recreational areas. Seedlings of *Corylus colurna* are used as rootstocks for the European hazelnut (*Corylus avellana*) because they do not produce suckers (Lagerstedt, 1993). Thus, labor costs to cut suckers or the necessity of chemical use for their removal can be avoided. Seeds (nuts) of naturally grown trees are collected and sold, eaten as a snack or used by the confectionery industry in some places (Ayfer et al., 1986; Mitrovic et al., 1997).

Seeds of the Turkish tree hazel have very thick shells and are difficult to crack (Erdogan and Aygun, 2005). There is a large scar at the bottom reaching almost half the length of the nut. The seeds usually require more than 6 months (Todorovic, 2000) or as long as 2 years for germination (Lagerstedt and Byers, 1968). The long germination time necessitates careful planning of sowing dates and the application of technical procedures in nurseries. In addition, it causes delayed seedling emergence and evaluations, thus slowing down breeding efforts. The objective of this study was to investigate the effects of some pre-treatments to hasten seed germination of Turkish hazel tree.

MATERIAL AND METHODS

The seeds of a *Corylus colurna* tree, about 50 years old, grown at the Hazelnut

Research Institute, Giresun, Turkey were used. The seeds were collected at harvest maturity, dehusked, dried and stored until used.

For field planting, the seeds were kept in water for 24h before being planted into a soil mix (50% sand + 50% soil) in November in a nursery row. The emergence of plants was observed in spring.

For the shell (endocarp) splitting treatment, seeds were kept for 24h in water to soften the endocarp. The seeds were planted into moist peat moss, after splitting the endocarp, and incubated at 22°C for 120 days for germination. For the acid scarification treatment, sulphuric acid (1:2 v/v seed:acid) was applied to the seeds for 3h, then washed in running water for 1h. The seeds were planted in peat moss and incubated at 22°C for 120 days.

Gibberellic acid (GA_3) was applied to the embryos of seeds in which the endocarp had been extracted by cracking. The seeds were kept in water for 24h to soften the endocarp to prevent damage to the embryo during cracking. The embryos were treated with 0, 25, 50, 75, 100, 200 and 400 ppm GA_3 for 24h, then placed between moist filter papers which were treated with benomyl in Petri dishes and were incubated at 22°C. Germinated embryos were counted daily for four weeks.

Cold stratification was also applied to the seeds. Seeds kept in water for 24h were planted into moist peat moss and incubated at 4°C for 100, 110 and 120 days.

Germinated seeds having 15-20 mm root length were transplanted into a peat moss + soil mix (1:1) in plastic bags. Development of seedlings was followed through the growing season.

Germination rate (%), germination speed (%) and seedling survival rate (%) were determined. The experiment was designed as a complete randomized design with three replications. ANOVA analysis was performed on data using SPSS software.

RESULTS AND DISCUSSION

Nursery planting in November resulted in 64% of germination which is in the acceptable range. Todorovic (2000) reported 33.7-90.3% germination. As she stated, genotype and years were responsible for a large variation in germination percentage. We planted the seeds in November but she suggested October planting rather than September or November for best results.

Acid scarification and shell-splitting treatments were not effective in seed germination. Absorption of water by a seed is required for germination. However, *C. colurna* seeds have thick and hard shells which reduce the permeability of the pericarp (Todorovic, 2000), forming a barrier for water penetration. For scarification, we applied sulphuric acid to the seeds for three hours. Our initial trials showed that shorter periods were not enough to scarify the shell while longer periods caused damage to the embryo. We also split the endocarp, without causing damage to the embryo, in order for water to penetrate into the seed through the opening. However both treatments were ineffective.

Stratification was partially effective. There was no germination after 100 and 110 days of stratification, while 120 days of stratification resulted in 14.2% of germination. *Corylus* seeds have a relatively long dormant period for germination and seed dormancy is mainly overcome by moist stratification at 4°C which may take 3-5 months (Mehlenbacher, 1994). For *C. colurna* genotypes, 97-135 days of cold-moist stratification plus an additional 52 days for germination processes was reported (Todorovic, 2000). The optimal time for removing seeds from stratification was the opening of pericarp (i.e., rupturing the seed coat at the joint). Our low germination results showed that seeds of the genotype used in this study may require a longer chilling period than 120 days. These results and other reports indicate that, although cold stratification breaks the dormancy, the time needed for it is long. In addition, more time for the germination processes is needed. Thus, cold stratification does not offer a significant advantage, for reducing the time needed for germination, over planting the seeds in the field, which requires about six or more months in breeding studies.

GA_3 treatment is an alternative to stratification. Our preliminary studies with

several genotypes showed that there might be serious decay problems on certain genotypes after GA_3 application during germination. However, we have not observed any decay problems on the seeds of the genotypes used in this study. Application of GA_3 resulted in germination at all of the concentrations (Fig. 1). The highest germination (100%) was obtained from 75 ppm application, followed by 50 ppm (92.1%) and 100 ppm (84.7%) GA_3. The control gave 41.3% of germination only. Interestingly, the germination percentage increased with increasing GA_3 concentrations up to a certain point (75 ppm), then decreased which implies that higher concentrations may have adverse affects on embryo germination. In the same way, Lagerstedt and Byers (1968) suggested the use of concentrations of 100 ppm or less gave the least deleterious effects.

Germination speed was also determined in GA_3 treatments. The fastest germination occurred in 75 ppm application followed by 50 ppm and 25 ppm applications (Table 1). Survival rate of transplanted seedlings was the highest at 25 ppm (70.6%) followed by 75 ppm (64.0%) and it was the lowest at 400 ppm (12.5%) treatment.

Embryo dormancy (insufficiently developed embryo or its segments) is one of the reasons for prolonged dormancy (Todorovic, 2000). However, Hartmann (1989) reported that *C. colurna* has no embryo dormancy. The dormancy is established only in the testa and is caused by inhibitors. Removal of the testa stimulates germination (about 80%). Similarly, Jarvis (1975) reported that dormancy in hazel seeds is induced by movement of inhibitors from the testa and pericarp through the cotyledons into the embryonic axis. Gibberellins, the synthesis of which occurs after ripening at low temperatures (Ross and Bradbeer, 1971), break this dormancy and affect both the metabolism of cotyledons (Pinfield and Stobart, 1969) and the early growth of embryonic axes (Jarvis and Wilson, 1977).

As a conclusion, our results show that GA_3 application accelerates the germination and increases the percentage of germination. A concentration of 75 ppm GA_3 is suggested for breaking dormancy and for achieving fast and the highest germination percentage of *C. colurna* seeds.

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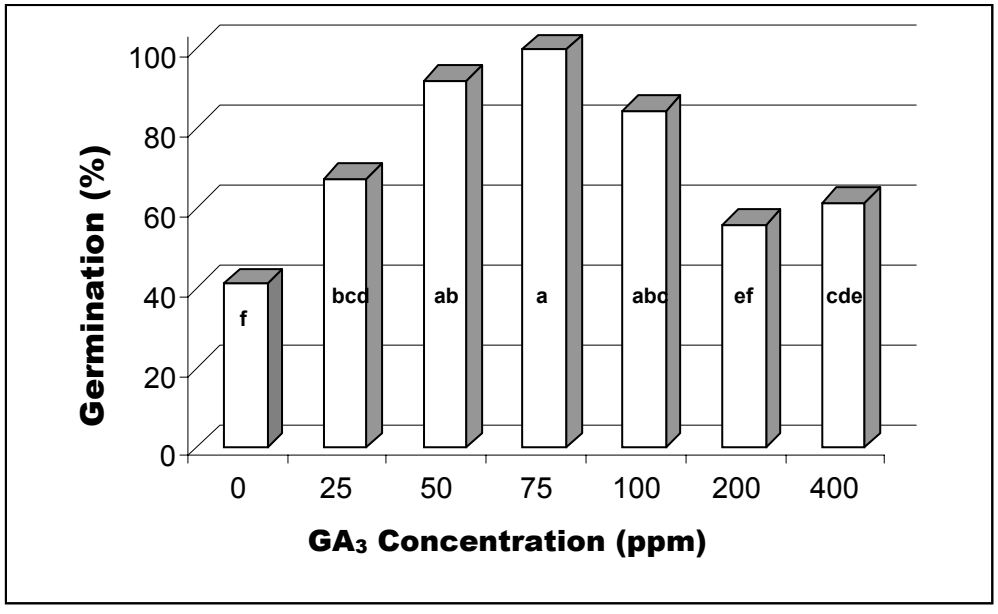
Tables

Table 1. Effect of GA_3 concentrations on germination speed of *C. colurna* seeds by weeks.

GA_3 concentration	Germination speed (%) by weeks				Total	Average
	1	2	3	4		
0 ppm	0.0	5.6	26.2	9.5	41.3	10.3 e
25 ppm	4.2	27.8	19.9	15.7	67.6	16.9 bcd
50 ppm	3.7	44.0	36.1	8.3	92.1	23.0 ab
75 ppm	8.3	52.8	27.3	11.6	100.0	25.0 a
100 ppm	4.2	42.6	30.6	7.4	84.8	21.2 abc
200 ppm	0.0	32.9	11.6	11.6	56.1	14.0 de
400 ppm	0.0	41.7	19.9	0.0	61.6	15.4 cde

LSD P≤0.05 :6.52

Figures



LSD P≤0.05 :26.24

Fig.1. Effect of GA_3 concentrations on germination of *C. colurna* seeds.