Journal of Environmental Biology **October 2006,** 27(4) 667-670 (2006)

Effects of cold stratification on germination rate and percentage of caper (*Capparis ovata* Desf.) seeds

Zafer Olmez[1], Askin Gokturk[1] and Suleyman Gulcu[2]
[1]Kafkas University, Artvin Faculty of Forestry, 08000 Artvin, Turkey
[2]Süleyman Demirel University, Faculty of Forestry, Isparta, Turkey

(Received: 11 August, 2005 ; Accepted: 26 December, 2005)

Abstract: *Caper is an important plant because of its high adaptability to marginal agriculture fields that are not suitable for agricultural crops. Different parts of caper such as roots, fruits, flowers and buds can be used to increase the inhabitant's income. The goal of this research is to determine germination rate and percentage of caper according to different duration of cold stratification (10, 20, 30, 40, 50 and 60 days) treatments. Cold stratification procedures under greenhouse condition were applied for eliminating seed dormancy to find the most suitable germination conditions because the presence of seed dormancy causes difficulties in seedling production. The seed germination started and stopped 21 and 57 days after sowing, respectively. While the highest germination percentage (46.6%) was obtained in seeds that were cold stratified for 60 days, the lowest germination percentage (3.67%) was determined in control seeds.*

Key words: *Capparis ovata Desf., Germination rate, Dormancy, Stratification.*

Introduction

Capparis ovata Desf., a prostrate shrub found in most arid zones of Mediterranean countries, are generally called "capers" in the literature (Pugnaire and Esteban, 1991; Tansi, 1999). They are well adapted and profited in countries such as Greece, Cyprus and Turkey and also cultivated commercially in Morocco, Spain, and Italy (Pascual *et al*., 2004). Caper shows the characteristics of a plant adapted to poor soils, where water and nutrients are major limiting factors (Neyisci, 1987). It is resistant to drought and heat damage and is often seen hanging, draped and spiraling as they scramble over soil and rocks (Barbera, 1991; Kara *et al*., 1996; Soyler and Arslan, 2000). Caper is an important plant because of its high adaptation ability to marginal agriculture fields that are not suitable for agricultural crops. Different parts of caper such as roots, fruits, flowers, and buds can be used to increase the inhabitant's income. It is also used with other plant species for controlling erosion in rocky and steep landscapes of many countries. In recent years, growing Caper shrub has become popular, owing to the increasing international demand for its pickled products (Kara *et al*., 1996; Pascual *et al*., 2004).

Although capers are widely grown on dry land where environmental conditions are difficult for the cultivation of other crops, it is difficult to propagate seedlings because of germination problems due to dormancy and hard seeds. The structure of the seed and the musilage which develops when the seed is placed in contact with water could impose an effective barrier against the diffusion of oxygen to the embryo (Orphanos, 1983). Recently there has been some interest in growing caper as a commercial crop but problems have arisen regarding the poor germination rate of the seed (Tansi, 1996 and 1999). Also, according to some researchers, there are germination obstacles in the caper seeds and; thus, there are propagation difficulties of caper seedlings (Orphanos, 1983; Barbera, 1991; Tansi, 1999; Olmez *et al*., 2004a). Sozzi and Chiesa (1995) attributed the poor germination of caper seed to dormancy, imposed probably by the seed coat.

Germination percentage of the caper seeds is approximately 5% and application of cold stratification, soaking in H_2SO_4, GA_3, and KNO_3 are well known methods to increase germination percentage (Sozzi and Chiesa, 1995; Tasni, 1999; Olmez *et al.,* 2004b).

The main objective of this research was to determine the germination percentage and rate of the caper seeds through cold stratification treatments under greenhouse conditions.

Materials and Methods

C. ovata ripe fruits were collected from wild plants growing in Artvin region, located in the Northeastern part of Turkey, in September 2002. The seeds were separated from the fruit material, rinsed in tap water, dried in the shade and kept at room temperature in linen sacks. Seed viability was determined by a tetrazolium test (Perry, 1987).

The seeds were stratified by putting layers of moistened sand and seeds on top of each other. Since there was a risk for seeds to be mixed with the sand because of their small size, linen cloth was placed between the sand and the seeds. The mean temperature of the room where cold stratification was applied on the seeds was 4.2 °C. The moisture of the sand was checked continuously as the sand was carefully and regularly watered so that the seeds should not become moldy. The moisture of the sand was measured by using moisture tester.

Six different cold stratification durations (10, 20, 30, 40, 50, 60 days) and control were applied on the seeds and they were sown in polyethylene pots under greenhouse condition in

Table – 1: Durations of cold stratification, germination rate, days beginning and ending of germination of caper seeds.

Durations of cold stratification	Germination rate (day)	Days beginning of germination	Days ending of germination
10 days	36.6	28	42
20 days	31.7	21	42
30 days	35.9	21	42
40 days	28.9	21	57
50 days	31.9	21	42
60 days	26.6	21	42
Control	53.3	42	57

Table – 2: Results of statistical analyses showing the relationship of the germination percentage with different cold stratification durations (Means in column with the same letter are not significantly different at α = 0.05).

Treatment	Durations of cold stratification	Number in sample (N)	Germination percentage	ANOVA (F ratio)	Newman Keuls test results
Germination–stratification	Control	120	3.67	10.36*	a
	10 days	120	13.27		ab
	30 days	120	16.23		ab
	20 days	120	26.60		bc
	40 days	120	38.47		cd
	50 days	120	44.37		d
	60 days	120	46.63		d

* : significant at 95% significance level

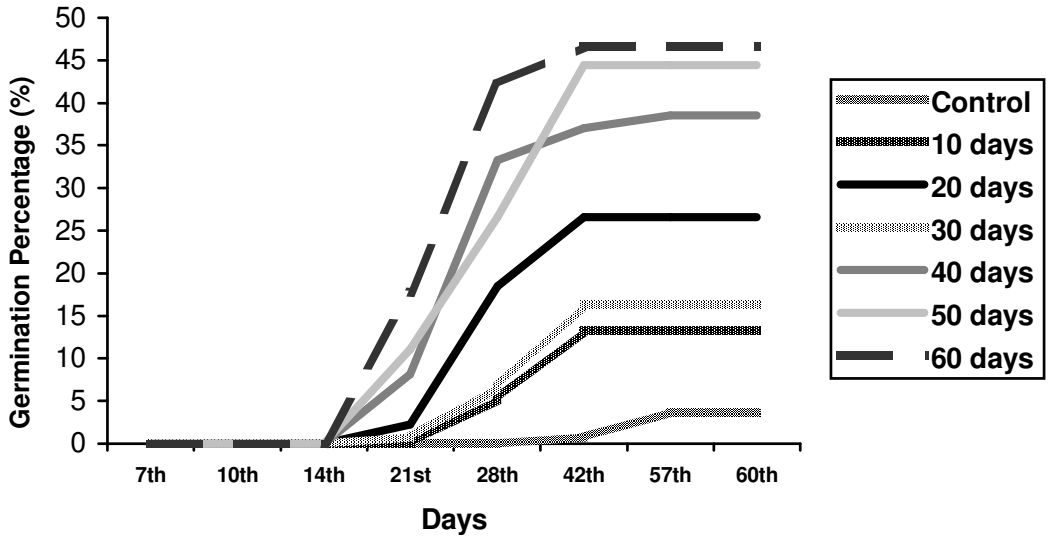

Fig. 1: Germination rate of caper seeds with different durations in stratification.

the spring (March) of 2003. Polyethylene pots were filled with growing medium composed of forest soil, creek sand and manure (1:1:1). The experimental design was a randomized complete block with three replications (40 pots for each replication) for every treatment. Pots were kept under greenhouse conditions after sowing.

Number of germinated seeds were counted every day, but recorded for 7th, 10th, 14th, and 21st days only and in every two weeks (14 days) after the 21st day counting. Germination percentage and rate were determined according to stratification time applied. Below formula was used when determining germination rate (Pieper, 1952):

$$GR = \frac{(n1 \times t1) + (n2 \times t2) + (n3 \times t3) + ...(ni \times ti)}{T}$$

GR: Germination rate,
n: Number of days for each counting of germinated seeds.
t: Number of germinated seeds in each counting day.
T: Total number of germinated seeds.

The experiment approximately lasted for two months when it was observed that the seeds stopped germination. Data

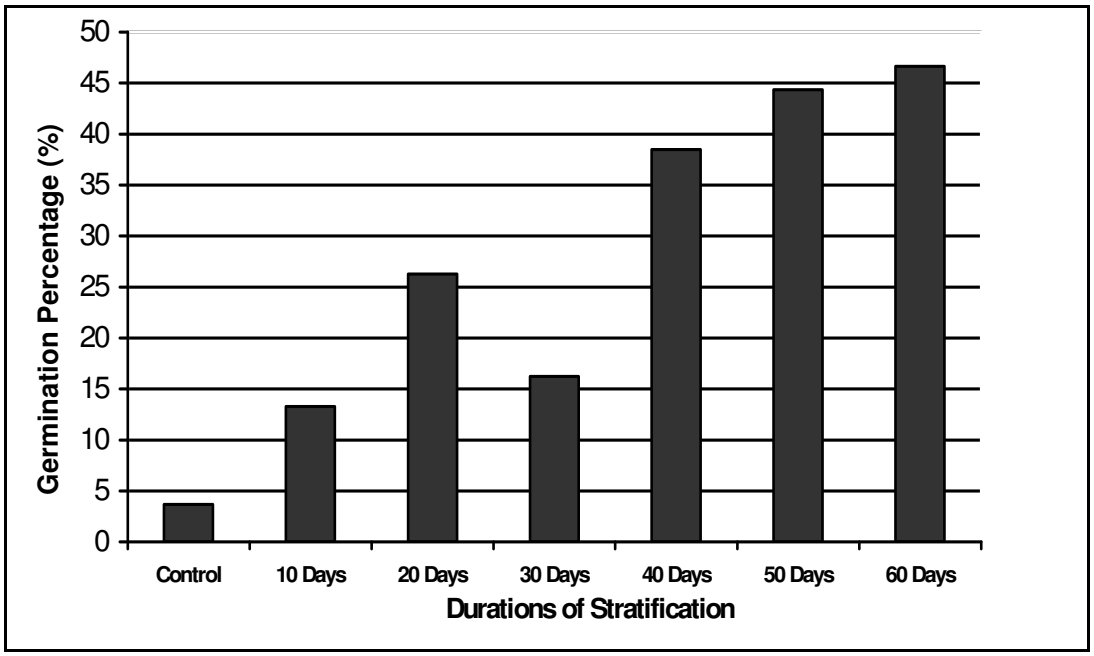

Fig. 2: Germination percentage of caper seeds with different durations in stratification

from the treatments was analyzed by the SPSS version 9.0 after Arcsinus transformation. The ANOVA and Newman Keuls tests were used to compare treatment groups as to whether or not they show any statistically significance differences which was set at α = 0.05.

Results and Discussion

Both the best germination rate the lowest number of days for germination (27 days) (Table 1, Fig. 1) and the highest germination percentage (46.6%) (Table 2, Fig. 2) were recored in seeds which were cold stratified for 60 days. Olmez *et al*. (2004b) suggested that caper seeds should be stratified at 4°C for 20-60 days in order to eliminate germination difficulties of the seeds.

The seed germination started 21 days after sowing for this treatment, which is well lower than the study done by Soyler and Arslan (2002) who found an average of 11 days of germination rate in laboratory conditions for *C. ovata* seeds.

The lowest germination percentage, 3.67%, was determined in control seeds. Number of days for germination of seeds -germination rate was also the highest, 53 days, for the control treatment. For other treatments, the germination percentages were 13.3%, 26.6%, 16.3%, 38.5%, and 44.4% with the stratification duration of 10, 20, 30, 40, and 50 days, respectively (Table 2).

The results indicated that the duration of cold stratification was positively effective on germination percentage and rate of the seeds. When the duration of cold stratification increases, the germination percentage of the seeds was increased, but the average rate of germination was decreased. Our findings on germination of caper seeds were confirmed by the results of Barbera (1991), Ayanoglu and Mert (1999) and Olmez *et al.* (2004b) as they also suggested that the duration period of cold stratification treatment were effective on removing germination obstacle of caper seeds.

Six different durations of cold stratification were compared under greenhouse condition in order to remove the obstacle to seed germination. The highest germination percentages (46.6%) and the best germination rate were obtained with 60 days stratification under greenhouse condition.

Acknowledgments

The Authors would like to thank Drs. Fatih Temel and Mehmet Ozalp for their input in the manuscript preparation.

References

Ayanoglu, F. and A. Mert: Farklı soğuklama süresi ve kimyasal uygulamaların iki kebere türünde (*Capparis spinosa* L., *Capparis ovata* Desf.) tohum çıkışı üzerine etkileri. *AÜ Ziraat Fakültesi Tarım Bilimleri Dergisi*, **5(2)**, 77-80 (1999).

Barbera, G.: Programme de Recherche Agrimed le Caprier (*Capparis* spp.). Comission des Communautes Europeennes, Serie Agriculture, EUR 13617, Luxenburg, pp 62, (1991).

Kara, Z., F. Ecevit and S. Karakaplan: Toprak koruma elemanı ve yeni bir tarımsal ürün olarak kapari (*Capparis* spp.). Tarım-Çevre İlişkileri Sempozyumu, Mersin, pp. 919-929 (1996).

Neyisci, T.: A study on the slow burning plant species suitable for controlling forest fires. *Turk J. Agric. For.*, **11 (3)**, 595-604 (1987).

Olmez, Z., Z.Yahyaoglu and A.Ö. Üçler: Effects of H_2SO_4, KNO_3 and GA_3 treatments on germination of caper (*Capparis ovata* Desf.) seeds. *Pakistan Biol. Sci.*, **7 (6)**, 879-882 (2004a).

Olmez, Z., A.O. Ucler and Z. Yahyaoglu: Effects of stratification and chemical treatments on germination of caper (*Capparis ovata* Desf.) seeds. *Agr. Med.*, **134(2),** 101-106 (2004b).

Orphanos, P.I.: Germination of caper seeds. *J. Hort. Sci.*, **58 (2)**, 267-270 (1983).

Pascual, B., A. San Bautista, A. Imbernon, S. Lopez-Galarza, J. Alagarda and J.V. Maroto: Seed treatments for improved germination of caper (*Capparis spinosa*). *Seed Sci. Technol.*, **32**, 637-642 (2004).

Perry, D.A.: Topographical Tetrazolium Test. In ISTA handbook of vigor test methods, International Seed Testing Association, Zürich, Switzerland, pp. 57-65 (1987).

Pieper, A.: Das saatgut. V.P. Darey Berlin, Hamburg, (1952).

Pugnaire, F.I. and E. Esteban: Nutritional adaptations of caper shrub (*Capparis ovata* Desf.) to environmental stress. *J. Plant Nutrition*, **14 (2)**, 151-161 (1991).

Soyler, D. and N. Arslan: The effects of some plant growing regulators on the rooting of capers (*Capparis spinosa* L.). *Turk. J. Agric. For.*, **24**, 595-600 (2000).

Soyler, D. and N. Arslan: Kebere (*Capparis ovata*) tohumlarında çimlenme hızının belirlenmesi üzerine bir araştırma. 1. Tohumculuk Kongresi, 11-13 Eylül, İzmir, pp. 315-323 (2002).

Sozzi, G. and A. Chiesa : Improvement of caper (*Capparis spinosa* L.) seed germination by breaking seed coat-induced dormancy. *Scientia Horticulturae*, **62 (4)**, 255-261 (1995).

Tansi, S.: Keberenin (*Capparis* spp.) önemi ve üretimi. *ÇÜ Ziraat Fakültesi Dergisi*, **11 (4)**, 147-154 (1996).

Tansi, S.: Propagation methods for caper (*Capparis spinosa* L.). *Agr. Med.*, **129**, 45-49 (1999).

Correspondence to :
Dr. Zafer Olmez
Kafkas University, Artvin Faculty of Forestry
08000 Artvin, Turkey
E-mail: zaferolmez@yahoo.com
Tel.: +90 4662126949
Fax: +90 4662126951