Propagation of Ornamental Plants
Vol. 9, № 1, 2009: 35-38

GERMINATION STUDIES OF *CAPPARIS SPINOSA* L.

Majda Khalil Suleiman*, Narayana Ramachandra Bhat, Mehdi Saleh Abdal, Sheena Jacob, Rini Rachel Thomas, Sarah Al-Dossery, and Ricardo Bellen

Aridland Agriculture and Greenery Department (AAD), Kuwait Institute for Scientific Research (KISR), P. O. Box 24885, Safat 13109, Kuwait, *Fax: + 965 4989849, *E-mail: mkhalil@safat.kisr.edu.kw

Abstract

For the development of vegetation in Kuwait, several ornamental trees and shrubs are being introduced and evaluated for their suitability under its harsh environmental conditions. Caper (*Capparis spinosa* L.) is a multipurpose crop native to Mediterranean area, known for its drought- and salinity tolerance and its ability to conserve soil moisture. Poor seed germination due to physical and physiological dormancy is a major limitation for its large scale cultivation. A study was carried out to investigate the effects of acid scarification followed by a combination of seed treatments including 0.04% gibberellic acid (GA_3), one, two or three weeks chilling or warm water treatment with one, two or three months chilling on germination of dry caper seeds that were sown either in Petri dishes or directly in the potting medium. The results showed that scarification with 1% H_2SO_4 for 20 min followed by 0.04% GA_3 and one week chilling at 4°C was the most effective in breaking dormancy of dry caper seeds and resulted in 64% germination in commercial substratum (SAB Potting Soil-Plantaflor) containing a nixture of slightly decomposed peat (white peat) and more strongly decomposed peat (frozen black peat) with organic mather less than 95% and nutrients like nitrogen (100-300 mg l^{-1}), phosphate (100-300 mg l^{-1}), and potassium (100-400 mg l^{-1}) as compared to warm water treatment with three months chilling, which gave 42% germination.

Key words: *Capparis spinosa*, chilling, dormancy, gibberellic acid, potting medium, scarification

INTRODUCTION

Caper (*Capparis spinosa)* is an ornamental shrub, native to Mediterranean area and tropics and very suitable for the climatical conditions of Kuwait (Kontaxis 1997, Alkire 1998, Brown 2001, FAO 2004, Olmez et al. 2004, Omar 2007). Caper plant is a multipurpose crop that can be used for culinary, cosmetics, pharmaceutical and medicinal purposes. As ornamental shrub, caper plant is used for the prevention of soil erosion in sloppy areas (Barbera et al. 1991, Soyler and Arslan 2000). The caper's vegetative canopy covers soil surfaces which help to conserve soil water reserves and control soil erosion (Soyler and Arslan 2000).

Caper plants have become popular owing to the increasing international demand for its pickled products, but problems have arisen regarding the poor germinability of the seeds (Tansi et al. 1997).

Caper plants can be propagated through seeds or stem cuttings; however, both methods present serious problems and restrictions to the commercial expansion of this crop. Fresh caper seeds germinate readily, but in low percentages (1-2%), whereas drying of seeds induces severe dormancy, which is difficult to overcome naturally (Olmez et al. 2004). As the dormancy in this crop is due to the hard seed coat, external treatments are necessary to overcome the prevailing dormancy (Alkire 1998, Sozzi and Chiesa 1995). Different seed treatments (mechanical or acid scarification and treatment with KNO_3 or GA_3) were tested to improve the germination percentage and to reduce longer germination (Orphanos 1983, Macchia and Casano 1993, Sozzi and Chiesa 1995, Soyler and Arslan 1999, Tansi 1999, Tansu and Kocabaa 1997). Pre-treatment with H_2SO_4 for 15-30 min was found to be an effective method to increase germination (Kara et al. 1996). High germination percentages were obtained using concentrated H_2SO_4, followed by a 90 min soaking in 0.01% gibberellic acid (GA_3) solution (Sozzi and Chiesa 1995). Warm water treatment combined with 65 to 70 days chilling stratification has also been suggested to improve germination (Kontaxis 1997). It has been reported that freshly harvested caper seeds presented the highest germination rate and the shortest time to reach 50% of the final percentage (Pascual et al. 2006). Previous studies have been focused on factors like maturity of fruit, time of collection, duration

Received: January 29, 2008

Accepted: December 15, 2008

of storage and methods of processing etc. Research studies on the seed germination of caper are scanty and insufficient. Moreover, the natural populations do not exist in Kuwait. Seeds are brought from outside. In view of these facts, an experiment was carried out to test the effectiveness of different seed dormancy breaking treatments in order to improve the germination of caper species under Kuwaiti conditions.

MATERIALS AND METHODS

Seed source

Seeds used in this study were obtained from B&T World Seeds Company, France. Viability was determined using Triphenyl Tetrazolium Chloride Test as recommended by the International Seed Testing Association (ISTA 1999).

Seeds were soaked in distilled water overnight and they were excised to expose the embryo and were then soaked in 0.1% 2,3,5-Triphenyl Tetrazolium Chloride solution in Petri dishes, covered with aluminum foil and kept for 24 h at 25°C. These seeds were washed thoroughly with distilled water to remove excess stain and were then examined under the microscope. A total of 100 seeds (four replicates of 25 seeds each) were used for the study.

Germination studies

The experiments were carried out in the Plant Physiology Laboratory at Kuwait Institute for Scientific Research (KISR).

The first experiment was initiated on 14th April, 2007. The seeds were initially immersed in warm water at 40°C and then soaked for 24 h in water at 25°C after which they were wrapped in a moist cloth, placed in a sealed glass jar and kept in the refrigerator at 4°C. Seed samples were taken after one, two and three months of incubation in the refrigerator and after soaking in warm water overnight, germinated in 9 cm diameter disposable Petri dishes lined with moist filter paper or jiffy pots filled with commercial substratum (SAB Potting Soil-Plantaflor). SAB Potting Soil contained a mixture of slightly to moderately decomposed peat (white peat) and more strongly decomposed peat (frozen black peat) with organic matter less than 95% and nutrients like nitrogen (100-300 mg l^{-1}), phosphate (100-300 mg l^{-1}) and potassium (100-400 mg l^{-1}), called soil substratum in this paper.

Execution of the second experiment was on 10th April, 2007. Seeds were soaked in warm water overnight and treated with 1% H_2SO_4 for 20 min followed by 0.04% GA_3 for two h prior to chilling stratification treatment for one, two and three weeks at 4°C. Treated seeds were sown in Petri dishes or jiffy pots with soil substratum.

Untreated seeds were used as control and sown in Petri dishes or jiffy pots with soil substratum.

Subsequent to dormancy breaking treatments, the seeds were placed on filter paper in Petri dishes, covered with a thin layer of absorbent cotton and placed in the growth chamber that was adjusted at 25°C for germination. Correspondingly, seeds were sown in jiffy pots with soil substratum and kept under indoor laboratory conditions at 25°C and humidity was maintained by covering the trays, holding the pots, with transparent plastic lids. Each treatment was replicated five times with 20 seeds in each replicate and germination was recorded until six months after sowing.

The seed germination data were analyzed using analysis of variance (ANOVA) R procedure and Dunkan's Multiple Range Test to separate significant treatment means (Little and Hills 1978, Crawley 2005).

RESULTS AND DISCUSSION

Viability of seeds used in these studies was 75%. Results showed that untreated control seeds did not germinate in both - Petri dish or soil substratum (Tables 1 and 2). The seeds that were scarified with 1% H_2SO_4, soaked in 0.04% GA_3, chilled for one week and then sown in soil substratum resulted in 64% germination, whereas only 24% of the treated seeds sown in Petri dishes germinated in six months. These observations suggest that soil substratum plays a vital role in promoting the germination. In contrast, treating the seeds in warm water and chilled for one month or two months or treating seeds with 1% H_2SO_4, followed by immersing with 0.04% GA_3 and then chilling for two weeks or three weeks resulted in low germination irrespective of the sowing medium used. Comparatively high germination percentage of 24% and 42% was obtained in seeds pre-treated with warm water, chilled for three months and then, sown in the potting soil substrate and Petri dish, respectively (Table 2).

The results showed that in experiment one (warm water pre-treatment), treatment and substratum caused a significant variation in germination percentage at $p \leq 0.001$ and $p \leq 0.05$ levels respectively (Multiple R-Squared = 0.675). No interaction was significant in this experiment. In experiment two (scarification with GA_3) both treatment and medium caused significant variation in germination percentage at $p \leq 0.001$. Multiple R-Squared value was 0.8911 explaining the importance of the factors affecting the germination percentage in this experiment. Interaction between treatment and germination substratum was also significant at $p \leq 0.001$.

The germination percentage of 64% for dry seeds in the present study is a clear improvement over the previous reports of Soyler and Arslan (1999) who recorded only 28% of germination of caper seeds that were treated with GA_3 + KNO_3 + scarification at 20°C under a 12 h photoperiod. Similarly, Macchia and Casano (1993) observed 38% germination of caper

Table 1. Effects of acid scarification and other pre-sowing treatments on total germination of caper (*Capparis spinosa*) seeds (Experiment 2, 10th April, 2007).

Pre-treatments	Medium	Germination %
1% H_2SO_4 + 0.04% GA_3 + 1 Week Chilling	Filter paper	24 ± 3.99 b
	Soil substratum	64 ± 7.47 c
1% H_2SO_4 + 0.04% GA_3 + 2 Weeks Chilling	Filter paper	6 ± 2.45 a
	Soil substratum	10 ± 0.00 a
1% H_2SO_4 + 0.04% GA_3 3 Weeks Chilling	Filter paper	4 ± 2.45 a
	Soil substratum	8 ± 3.74 a
Control (no treatment)	Filter paper	0 ± 0.00 a
	Soil substratum	0 ± 0.00 a

Seeds with 2 mm or longer radicle or shoot are considered as germinated.
The means in the column followed by the same letter are not statistically different at $p \leq 0.001$.

(*C. spinosa* L.) seeds scarified with H_2SO_4 for 15 min before treating them with 0.05% GA_3 at 10-30°C. Yildrim (1998) obtained 53% germination from the combination of 15 min soaking in concentrated H_2SO_4 + 24 h soaking in 0.005% GA_3. Koc (2001) recorded a germination rate of 46.33% after treatment with 0.06% GA_3 for 3 h. From these results it can be inferred that scarification and chilling stratification treatments are effective in breaking the seed dormancy in caper. Acid scarification facilitates imbibition of dry seeds by rupturing the seed coat, whereas the combined treatments of seeds with GA_3 and one week chilling effectively overcome the physiological dormancy. Pre-chilling stratification treatments helps in maturation of embryos and accumulates sufficient quantities of hormones prior to the initiation of germination process (Evans and Blazich 1994). The observation made in these studies suggest that GA_3 and/or KNO_3 reduced the duration of the chilling stratification treatment which indicated that the embryonic seedlings in dried Caper seeds do not have proper hormonal balance to initiate metabolic processes associated with germination on their own without external treatments. These findings clearly suggest that both the physical (hard seed coat) and physiological (immature embryo, hormonal imbalance) factors are responsible for seed dormancy in this crop. Therefore, a combination of treatments involving seed scarification, increased imbibition of water or chemical solution (GA_3 or KNO_3) and chilling stratification was more effective than isolated ones. These treatments led to weakening of seed coat thus allowing the entry of water into the seed and established proper hormonal balance required for the initiation of germination process. Additionally, treated seeds sown in soil substratum produced enhanced results than the seeds sown in Petri dishes proving that the substratum used has a significant influence on the germination of fresh caper (*Capparis spinosa*) seeds.

Results of the present study are significant because they were obtained with dry seeds and data were recorded for six months allowing sufficient periods for maximum germination to take place (Thompson 1979).

Results of the present stady are significant because they were obtained with dry seeds in which dormancy is rampant and data were recordered for six months allowing sufficient periods for maximum germination. Seeds require a long test period in species in which

Table 2. Effects of pre-sowing treatments on total germination in caper (*Capparis spinosa*) seeds (Experiment 1, 14th April, 2007).

S. No.	Pre-treatments	Medium	Germination %
T_1	Warm Water 1 Month Chilling	Filter paper	6 ± 3.99 ab
		Soil substratum	18 ± 7.34 bd
T_2	Warm Water 2 Months Chilling	Filter paper	8 ± 2.00 ab
		Soil substratum	12 ± 5.82 abc
T_3	Warm Water 3 Months Chilling	Filter paper	24 ± 6.77 c
		Soil substratum	42 ± 3.74 d
T_4	Control (no treatment)	Filter paper	0 ± 0.00 a
		Soil substratum	0 ± 0.00 a

Seeds with 2 mm or longer radicle or shoot are considered as germinated.
The means in the column followed by the same letter are not statistically different at $p \leq 0.001$.

dormancy is common (Thompson 1979) and a reduction of the test period would obviously affect the final germination percentage.

CONCLUSIONS

As germination in caper (*Capparis spinosa*) is controlled by both physical and physiological factors, pre-sowing treatments are necessary to overcome the dormancy. Acid scarification followed by addition of GA_3 solution to the germination substrate and one week chilling is a simple, efficient and cost effective method for ensuring satisfactory seed germination. The described procedure could help in improved germination of seeds in pots or nurseries before transplanting seedlings to the desired places in the field for urban landscaping. Taking into account, the significant variation in germination percentage due to medium in which the capers (*Capparis spinosa*) are grown, further experiments should be conducted to study the role played by medium on germination of caper (*Capparis spinosa*).

Acknowledgement: The project team would like to extend their appreciation to the Kuwait Foundation for the Advancement of Sciences (KFAS) and Kuwait Institute for Scientific Research (KISR) for providing funds and encouragement during the investigation.

REFERENCES

Alkire B. (1998). Capers. Purdue New Crop FactSheet. Center for New Crops and Plant Products. Purdue University. http://www.hort.purdue.edu/newcrop/cropfactsheets/caper.html

Barbera G., Di-Lorenzo R., Barone E. (1991). Observations on *Capparis spinosa* populations cultivated in Sicily and on their vegetative and productive behavior. Agricoltura Mediterranean, 121 (1): 32-39.

Brown G. (2001). Vegetation ecology and biodiversity of degraded desert areas in north-eastern Arabia. Habilitation Thesis, Rostock University, 190 pp.

Crawley M. J. (2005). Statistics: An Introduction using R. England, John Wiley & Sons Ltd.: 155-185.

Evans E., Blazich F. A. (1994). Overcoming seed dormancy: Trees and Shrubs. North Carolina Cooperative Extension Service. North California State University Horticulture Information Leaflet-8704, 5 pp.

Food and Agricultural Organization (2004). AQUASTAT- FAO's Information System on Water and Agriculture. http://www.fao.org/nr/water/aquastat/countries/kuwait/index.stm.

International Seed Testing Association (ISTA) (1999). International rules for seed testing. Seed Science and Technology, 27: 333.

Kara Z., Ecevit F., Karakaplan S. (1996). Toprak koruma elemani ve yeni bir tarismal urur olarak kapari (*Capparis spinosa* spp.). Tarim-Cevre Iliskileri Sempozyyumu. Mersin: 919-929 (in Turkish).

Koc H. (2001). Germination of Caper (*Capparis spinosa* L.) seeds. Beletinul Universitãtii de Stiinte Agricolr Seria Medicinã Veterinarã Cluj-Napoca. Seria Agriculturã, 55/56: 292-296 (in Romanian).

Kontaxis D. G. (1997). Caper. Speciality and Minor Crops Handbook. Small Farm Center, University of California, Davis, 4 pp.

Little T. M., Hills F. J. (1978). Agricultural experimentation gesign and analysis. USA: John Wiley & Sons Inc.: 63-65.

Macchia M. Casano S. (1993). Propagation of Caper (*Capparis spinosa*). Sementi Elette, 39: 37-42.

Olmez Z., Yahyaoglu Z., Ucler A. O. (2004). Effects of H_2SO_4, KNO_3 and GA_3 treatments on germination of caper (*Capparis ovata* Desf.) seeds. Pakistan Journal of Biological Sciences, 7 (6): 879-882.

Omar S. A. S., Al-Mutawa Y., Zaman S. (2007). Vegetation of Kuwait. Kuwait Institute for Scientific Research, Kuwait: 34-159.

Orphanos P. I. (1983). Germination of caper seeds. Journal of Horticultural Science, 58: 267-270.

Pascual B., San Bautista A., Imbernon A., Lopez-Galarza S., Alagarda J., Marto J. V. (2006). Germination behaviour after storage of caper seeds. Seed Science and Technology, 34 (1): 151-159.

Soyler D., Arslan N. (1999). Effect of heat, light and dark treatments on seed germination of capers (*Capparis spinosa* L.). Anadolu, 9: 63-75.

Soyler D., Arslan N. (2000). The effects of some plant growing regulators on the rooting of capers (*Capparis spinosa* L.). Turkish Journal of Agriculture and Forestry, 24: 595-600.

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

Tansi S. (1999). Propagation methods for Caper (*Capparis spinosa* L.). Agricoltura Mediterranea, 129: 45-49.

Tansi S., Culcu A., Nacar S. (1997). The researches on the germination of Caper. Turkiye II. Tarla Bitkileri Kongressi. Samsun: 681-683.

Tansu S., Kocabaa F. (1997). Importance of caper (*Capparis spinosa* L.) under forest ecosystem and its cultivation. *In:* Mukerji A. K. (Ed.). XI World Forestry Congress, Antalya, Turkey, 13 to 22 October., Vol 3, Topic 15: 259 (Abstract).

Thompson J. R. (1979). An introduction to seed technology: Testing for Germination Capacity and Vigour. Leonard Hill, London, UK, 252 pp.

Yildrim Z. (1998). Studies on the improvement of seed germination in Caper. Turkish Journal of Field Crops, 3 (1): 21-24.