

Seed Germination of Caper (*Capparis ovata* var. *Herbacea*) Using α Naphthalene Acetic Acid and Gibberellic Acid

DURMUSALI SOYLER AND KHALID MAHMOOD KHAWAR^{1†}

Variety Registration and Seed Certification Department, General Directorate of Protection and Control, Ministry of Agriculture and Rural Affairs, Ankara - Turkey

[†]Agricultural Biotechnology section, Institute of Biotechnology, Department of Field Crops, Faculty of Agriculture, University of Ankara, 06110, Dışkapı, Ankara, Turkey

¹Corresponding author's e-mail: kmkhawar@gmail.com; bhatti@ankara.edu.tr; Tel: + 90-312-3179815; Fax: + 90-312-3179815

ABSTRACT

Poor seed germination is the major problem in wide scale cultivation of capers (*Capparis ovata* var. *herbacea*). The present study was conducted to examine the role of NAA and GA₃ in breaking seed dormancy and determine the extent of their effectivity in seed germination of *C. capparis ovata* var. *herbacea*. The Seeds were initially immersed in warm water (40°C) overnight and treated with H₂SO₄ for 20 min. These seeds were left out in the germination cabinets, for 28 days by soaking them in 100, 250, 500 or 2000 mg/l of NAA and GA₃ each for 1/2, 1, 2, 6, or 24 h. The highest germination rate of 61% was obtained from the seeds treated with GA₃ for 24 h.

Key Words: *Capparis ovata*; Seed germination; *In vitro*

Abbreviations: NAA- α Naphthalene acetic acid, GA₃, Gibberellic acid, H₂SO₄, Sulphuric acid

INTRODUCTION

Caper (*Capparis spinosa* or *Capparis ovata* var. *herbacea* (Wild) Zoh.) belongs to family: *Capparidaceae* and is said to be native to the Mediterranean region, but it is also found and cultivated on the Atlantic coasts of the Canary Islands, Morocco, Spain (Almeria, Grenada & Balearic Islands), France (Provence) and Italy (especially Sicily & the Aeolian island of Salina & the Mediterranean island of Pantelleria), Greece, Cyprus, Turkey and Iran both under cultivated and rain fed conditions (Zohary, 1960).

Tender young shoots, including immature small leaves or immature flower bulbs are some times eaten as a vegetable, or pickled. Capers are said to reduce flatulence and have anti-rheumatic properties. Capers have reported uses for arteriosclerosis, as diuretics, kidney disinfectants, vermifuges and in folk therapy. Moreover, infusions and decoctions from caper root bark have been traditionally used for dropsy, anemia, arthritis and gout. Capers contain considerable amounts of the anti-oxidant bio-flavinoid rutin (Bailey, 1950).

Caper plants are small shrubs and may reach about one meter height. However, wild caper plants grow spontaneously in cracks and crevices of rocks and stone walls or in nutrient poor sharply-drained gravel soils. They also are salt-tolerant and flourish along shores within sea-spray zones. (Pugnaria & Esteban, 1991; Macchia & Casano, 1993). Mature plants develop large extensive root systems that penetrate deeply, which helps to reduce soil erosion.

Breeding of capers is complicated by limited and variable seed germination under natural conditions. The problem becomes serious when the plantations of these are required for greater production. To ensure high plantation and viability, a high germination percentage is required. Germination using plant growth regulators has been reported previously for many plants (Russo & Berlyn, 1990; Crunkilton *et al.*, 1994; Swaminathan & Srinivasan, 1996). The effects of temperature, light, pre soaking treatment and removal of seed coat have been reported to effect germination of various crops (Murthy & Saxena, 1965; Depauw & Remphery, 1993; Shankarraja & Sulikeri, 1993; Kyauk *et al.*, 1995). Information on seed germination of capers is still limited. Therefore, it was thought that treatment of the seeds with Plant growth regulators may influence root formation and rapid germination.

The present study was conducted to examine the importance of NAA and GA₃ that might affect germination of capers seeds and study the possible advantages of *in vitro* germination over direct sowing of seeds in the soil. The present study reports the outcome of preliminary investigations aimed at maximizing seed germination and obtaining seedlings of capers under controlled conditions using NAA and Gibberellic acid.

MATERIALS AND METHODS

The seeds used in the study were collected from the Tokat province of the Black sea region, Turkey (Davis, 1965), where capers grows abundantly. Soon after, the seeds

were soaked in warm water (40°C) over night and treated with sulfuric acid (H₂SO₄) for 20 min before they were incubated in the germination cabinets in white light (42 μMol photons m⁻²s⁻¹) at 22°C, for 28 days by soaking them in 100, 250, 500 or 2000 mg/l of NAA and GA₃ for 1/2, 1, 2, 6 and 24 h.

The seed germination data were analyzed using analysis of variance (ANOVA) and the differences between the means were compared by LSD test using MSTAT-C computer program (Michigan State University). Data given in percentages were subjected to arcsine (\sqrt{X}) transformation (Snedecor & Cochran, 1967) before statistical analysis.

RESULTS AND DISCUSSION

The zygotic embryos of 49 out of 50 seeds sampled randomly stained red with tetrazolium (ISTA, 1999) showing viability of large majority of seeds. A comparison to observe the effect of various concentrations of NAA for variable treatment times showed a positive effect of the NAA on seed germination (Table I). The highest seed germination of 22% was achieved when the seeds were treated for 30 min with 2000 mg/l NAA solution. The roots observed from the seedlings were 2 to three times longer and vigorous compared to those obtained from the control. The highest germination in each case was obtained from seeds soaked for 6 h in NAA, which tended to drop thereafter. The drop in germination was very sharp in case of 2000 mg/l at 12 and 24 h of NAA soaking. We speculate that, increase in duration of soaking with any concentration of NAA was inhibitory. The degree of reduction in germination was variable. In general longer soaking in NAA was not good and was accompanied with reduced or no germination. It is hypothesized that the usual slow growth rate of caper seeds in soil is primarily due to poor rooting, which is the result of auxin deficiency. Bhattacharya and Khuspe (2001) also found that NAA has positive effect on seed germination of papaya (*Carica papaya* L.) seeds under *in vitro* culture. Similarly Balestri and Bertini (2003) found that application of Naftal active ingredient α Naphthalene acetic acid for 1 h stimulated the initiation and growth of adventitious roots in seedlings with two three fold reduction of time for root emergence as well as two three fold longer roots compared to the non-treated control. No dose dependent effects were detected. Due to the reason if extrapolated to field conditions, the obtained seedling from seeds germinated after treatment with NAA could result in high probability of success following transplanting.

Gibberellic acid is known to play an essential role in seed germination, leaf expansion, stem elongation flowering and flower development (Yanmaguchi & Kamiya, 2002). The highest seed germination of 20 and 26% in case of 100 and 250 mg/l was achieved after 6 h of soaking in GA₃. Longer treatment time was inhibitory in each case. However for 500 and 2000 mg/l, the highest germination of 45 and

Table I. Effect of NAA on seed germination percentage of *C. ovata* var. herbacea

Soaking time	Treatment dose (mg/l)				
	100	250	500	1000	2000
½ hour.	9.5 c	14.5 a	17.0 a	19.0 b	22.0 a
1 hour	4.0 d	6.0 c	5.0 b	9.0 d	9.0 c
2 hour	12.0 c	18.0 a	14.0 a	14.0 c	13.0 b
6 hour	21.0 a	18.0 a	17.0 a	22.0 a	19.0 a
12 hour	16.0 b	11.0 b	14.0 a	10.0 d	4.0 d
24 hour	17.0 b	17.0 a	14.0 a	15.0 c	0.0 c
Control	5.0	5.0	5.0	5.0 e	5.0

Each value is the mean of 4 replicates each with 10 seeds.

¹Values with in a column followed by different letters are significantly different at 0.01 level using Duncan's Multiple Range Test

Table II. Effect of GA₃ on seed germination percentage of *C. ovata* var. herbacea

Soaking time	Treatment dose (mg/l)				
	100	250	500	1000	2000
½ hour.	11.5 c	14.0 c	15.0 d	22.5 d	27.5 d
1 hour	9.0 c	14.0 c	15.0 d	22.0 d	24.0 d
2 hour	14.5 b	20.0 b	25.0 c	29.0 c	34.5 c
6 hour	20.0 a	26.0 a	35.0 b	37.0 b	27.0 d
12 hour	10.0 c	17.0 bc	28.0 c	39.5 b	42.0 b
24 hour	16.0 b	20.0 b	45.0 a	53.0 a	61.0 a
Control	5.0	5.0	5.0	5.0	5.0

Each value is the mean of 4 replicates each with 10 seeds

¹Values with in a column followed by different letters are significantly different at 0.01 level using Duncan's Multiple Range Test

61% was obtained after 24 h soaking in GA₃. Lower soaking times had inconsistent effect in each case resulting in irregular increases or decreases in germination. In general 2000 mg/l GA₃ treatment resulted in more vigorous seed germination at any duration compared to any other concentration of the Gibberellic acid. This means that the regulation of endogenous GA levels after seed imbibitions is crucial factor in determining seed germination. Germination in each case was superior over control (5%). When a comparison is made between GA₃ and NAA treatments, we find GA₃ superior to NAA in breaking seed dormancy and was better with positive effects on germination.

Low germination percentage in case of control was possibly due to the seed coat of the capers that forms mucilage on soaking in water. The mucilage surrounding the seed is supposed to inhibit diffusion of Oxygen to the embryos prevent germination. Sulphuric acid treatment to remove mucilage and soaking in either of NAA or GA₃ was found effective to allow penetration of Oxygen from the surroundings to the embryos and increased germination of seeds. In general we found GA₃ more effective compared to NAA. It is supposed that disruption of seed coat allowed diffusion of Oxygen in interaction with both growth regulators positively removed seed dormancy. Our results are in agreement with that Negbi *et al.* (1966) for *Hirschfeldia incana* and Orphanos (1983), who found that the seed dormancy is mainly due to the seed coat that prevents germination. He observed that when the seeds get in touch with water, mucilage comes into existence on the

coat and hinders embryo to take O₂ preventing germination. He further points out that GA₃ has positive effect on germination. However, the relationship between GA₃ and O₂ is not known. Probably, GA₃ decreases the O₂ need for the germination. Mayer and Shahin (1974) views that the Gibberellins reduces oxygen requirement for germination. The germination percentage obtained in this case is higher than previously reported. The described method was found to be effective when the seeds were planted in pots and the germination percentage did not decline. It is speculated that under un-desirable environmental circumstances the seed coat may not be disrupted due to the action of soil bacteria. The described procedure could help in rapid and more germination of seeds in pots before transplanting the selected plants to the desired places in the fields.

Acknowledgement. We are very grateful to Prof. Dr. Neşet Arslan, Department of Field Crops University of Ankara for his positive criticism during writing of the manuscript.

REFERENCES

- Bailey, L.H., 1950. *The Standard Cyclopedia of Horticulture*, Vol. 1, P: 658. Macmillan Company New York-USA
- Balestri, E. and S. Bertini, 2003. Growth and development of *Posidonia oceanica* seedlings treated with plant growth regulators: possible implications for meadow restoration. *Aquatic Bot.*, 76: 291–7
- Bhattacharya, J. and S.S. Khuspe, 2001. *In vitro* and *in vivo* germination of papaya (*Carica papaya* L.) seeds. *Scientia Horticulturae*, 91: 39–49
- Crunkilton, D.D., H.E. Garret and S.G. Pallardy, 1994. Growth and ectomycorrhizal development of northern red oak seedlings treated with IBA. *Hortscience*, 29: 771–3
- Davis, P.H., 1965. *Flora of Turkey and the East Aegean Islands*, Vol. 1, Pp: 496–8. Edinburg University Press Edinburg-UK
- Depauw, M.A. and W.R. Remphery, 1993. *In vitro* germination of three *Cypripedium* species in relation to time of seed collection, media and cold treatments. *Canadian J. Botany-Revue Canadienne de Botanique*, 71: 879–85
- International Seed Testing Association (ISTA), 1999. *Seed Science and Technology*, Vol. 27, P: 333. International rules for seed testing
- Kyauk, H., N.W. Hopper and R.D. Brigham, 1995. Effect of temperature and pre-soaking on germination, root length and shoot length sesame (*Sesamum indicum* L.). *Environ. Exp. Bot.*, 35: 345–51
- Macchia, M. and S. Casano, 1993. Propagation of Caper (*Capparis spinosa* L.). *Sementi Elette*, 39: 37–42
- Mayer, A.M. and Y. Shahin, 1974. Control of seed germination. *Annual Rev. Pl. Physiol.*, 25: 167–93
- Murthy, B.N.S. and P.K. Saxena, 1998. Somatic embryogenesis and plant regeneration of neem (*Azadirachta indica* A. Juss.). *Pl. Cell Rep.*, 17: 469–75
- Negbi, M., E. Rushkin and D. Koller, 1966. Dynamic aspects of water relations in germination of *Hirschfeldia incana* seeds. *Pl. Cell Physiol.*, 7: 363–76
- Orphanos, P.I., 1983. Germination of caper (*Capparis spinosa* L.) seeds. *J. Hort. Sci.*, 58: 267–70
- Pugnaria, I.F. and E. Esteban, 1991. Nutritional Adaptations of Caper Shrub *Capparis ovata* Desf.) to Environmental Stress. *J. Pl. Nutrition Spain*, 4: 151–61
- Russo, R.O. and G.P. Berlyn, 1990. The use of organic bio-stimulants to help low input sustainable agriculture. *J. Sustainable Agric.*, 1: 19–42
- Shankaraj, N.S. and G.S. Sulikeri, 1993. Presowing treatments of seeds to improve germination in cardamom (*Elettaria cardamomum* L. Maton var minor Watt). *J. Plantation Crops*, 21: 116–7
- Snedecor, G.W. and W.G. Cochran, 1967. *Statistical Methods*. The Iowa State University Press, Iowa-USA
- Swaminathan, C. and M. Srinivasan, 1996. Seedling investigation through plant growth substances in teak (*Tectona grandis*) *J. Trop. For. Sci.*, 8: 310–6
- Yanmaguchi, S. and Y. Kamiya, 2002. Gibberellins and Light stimulated seed germination. *J. Pl. Growth Regul.*, 20: 369–76
- Zohary, M., 1960. The species of *Capparis* in the Mediterranean and the Near Eastern Countries. *Bul. Res. Coun. Israel*, 8: 49–64

(Received 31 July 2006; Accepted 12 October 2006)