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Effect of Rooting Hormones (IBA and NAA) on Rooting of Semi Hardwood Cuttings of *Capparis spinosa*

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Due to the harsh climatic condition of Kuwait, screening of heat and drought tolerant plants that can adapt to the arid conditions of the country is pivotal to the successful introduction of new ornamental plants in greenery and landscaping projects. *Capparis spinosa* is a drought resistant, stenohydric plant that prefers dry heat, intense sunlight and easily withstands summer-time temperatures higher than 40°C. These characteristic features of *Capparis spinosa* render this plant an ideal selection that has the potential to survive and grow under the local climatic conditions of the country. Mass propagation of caper plants for utilization in urban landscaping is restricted due to the dormancy of caper seeds and the time needed to produce a hardened plant for field use. Effect of varying concentrations (100, 200, 400 and 1000 ppm) of rooting hormones (IBA and NAA) to improve the rooting success of semi hardwood cuttings of *Capparis spinosa* were studied in this research. The study results showed that treating the semi hardwood cuttings of *Capparis spinosa* with 400 ppm IBA, 100 and 400 ppm NAA resulted in 79.39%, 65.45% and 75% respectively and the cost of which is far lesser than the previously proved treatments.

Key words: Vegetative propagation, urban landscape, *Capparis spinosa*, growth hormones, NAA, and IBA.

INTRODUCTION

Introduction and evaluation of various plants that are proposed to be included in greenery activities is necessary to evaluate their suitability to the harsh climatic conditions of the country. The use of multipurpose plants provides an invaluable opportunity to enhance greenery in Kuwait. Due to harsh climatic conditions of Kuwait, screening of heat and drought resistant plants that can adapt to the arid conditions of the country is vital to the successful introduction of new ornamental plants. Kuwait is characterized by extremely hot weather conditions, dry extended summer (with an average temperature of 46.2°C) and mild winter (with an average temperature of 6.9°C), scanty erratic rainfall (with an average of 110 mm/yr), low humidity (as low as 25% during summer) and strong winds [1-2].

Capparis spinosa (Caper plant) is a shrub native to the Mediterranean regions and tropics that grows wild on walls or in rocky coastal areas [3]. It is a deciduous dicotyledonous plant with a very deep root system. The plant is drought resistant, prefers dry heat, intense sunlight and can withstand summertime temperatures exceeding 40° C [3]. These characteristic features of *Capparis spinosa* makes this plant favourable due to its potential to survive under the climatic conditions of Kuwait.

However, Caper plant is a cold tender plant and has a temperature hardiness range similar to the Olive Tree [3]. It is a drought resistant plant, but requires good drainage. *Capparis spinosa* is a stenohydric plant, largely free from

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competition for water [4]. The Caper plant's vegetative canopy covers soil surfaces, which help to conserve soil water reserves. It tolerates salt and grows in wide range of soils and is a multipurpose crop that can be used for culinary, pharmaceutical and medicinal purposes [3]. As ornamental shrub, Caper plant is used for the prevention of soil erosion in sloppy areas [5-6].

Caper plants are mainly produced in Morocco, Spain, and Italy. The United States imports more than $20 million worth of processed Caper buds each year [7]. Caper shrubs are generally well adapted to dry areas receiving less than 200 mm rainfall annually, as most economically important commercial crops cannot be grown under such conditions without irrigation. Therefore caper shrubs are good candidates for cultivation [8]. Caper multiplication faces several difficulties in spite of it importance.

One of the major constraints of mass producing Caper plants is the difficulty in Caper plant propagation including poor germinability of its seed, and the rooting efficiency of its vegetative cuttings. Propagation is mainly carried out by seeds which generate high genetic flows resulting in low productivity and increased variability in Caper quality due to heterozygosity in its seeds [9] Fresh caper seeds germinate readily, but in low percentage (1-2%) whereas drying of seeds induces severe dormancy, which is difficult to overcome naturally [10].

Although tissue culture propagation is a convenient method of propagation; it is of ultimate necessity to develop and enhance seed and vegetative propagation techniques to ensure their adoption by the agricultural sector in Kuwait, including local agricultural nurseries, as they depend heavily on unskilled labors.

Vegetative propagation of woody plants are preferred as this method ensures true-to-type seedlings; as well as it develops seedlings at a faster rate for further utilization. Several experiments were conducted using various concentrations of indole-3-acetic acid (IAA), indolebutyric acid (IBA) and naphthalene acetic acid (NAA) to improve the rooting success in Caper vegetative cuttings. Treating the vegetative cuttings with 500 ppm IAA and 250 ppm IBA produced 28% and 29% rooting, respectively [6].

Dipping the herbaceous cutting in a 2000 ppm NAA also resulted in good rooting percentage [11]. Though not scientifically proved, use of well drained media with bottom heat and a dip in IBA solution of 1.5 to 3 ppm has been recommended by Alkire [3]. However, some researchers suggested that propagation using stem cuttings is not an economic method in this crop [12]. Research by Salem et al. on herbaceous cuttings of Caper concluded that spiny Caper varieties are difficult to multiply with herbaceous cuttings [13].

Though better results were reported by some researchers, there is a considerable difference between varieties and clones as regards rooting ability and the period of cutting i.e beginning of spring, summer, fall. also affects the success of rooting [13]. However, in-depth research should be done to enhance callusing and rooting development after sprouting to mass plant *Capparis spinosa* for culinary value in Kuwait, as seed germination methods are time consuming. In view of the above facts, the current study was initiated in 2009 with the aim of standardizing the vegetative propagation techniques for the mass propagation of *Capparis spinosa*, to enhance propagation of *Capparis spinosa* from semi-hardwood cuttings. For this purpose the effects of different hormones on development of roots was also evaluated.

MATERIALS AND METHODS

The effectiveness of different treatments in improving the rooting ability of Caper cutting was tested using a randomized complete design of nine treatments with five replications. Semi hardwood cuttings of *Capparis spinosa* were collected on 19.10.2009 from 2 year old caper plants which were procured from Australia in 2007, introduced into Kuwait and maintained at Urban Demonstration Gardens, Salmiya, Kuwait. The cuttings were 1.5cm in diameter and 15cm in length with 6-8 buds and collected when the plants were still dormant.

Vegetative stem cuttings (semi hardwood) were dipped in freshwater before treating them with different concentrations (100, 200, 400 and 1000 ppm) of lab prepared Indole Butyric Acid (IBA), Naphthalene Acetic Acid (NAA). To prepare 100, 200, 400 and 1000 ppm of IBA/NAA, the amount of hormones (IBA/NAA) used were 0.1, 0.2, 0.4 and 1g respectively.

IBA solutions were prepared by dissolving accurately weighed amounts of IBA (in 3ml absolute ethanol and making the solution up to 500ml (by adding absolute ethanol) with simultaneous stirring, followed by 500ml of distilled water [14-15]. 1N NaOH solution (40 g of NaOH pellets in 1 liter of water) was used to dissolve NAA and this was made up to 1 liter by adding distilled water. Control solutions contained similar amounts of ethanol (50%).

Collectively, there were nine treatments with five replications. In each replication, there were four cuttings. Quick dip method was used to treat the cuttings with rooting hormones. Following the treatment, vegetative cuttings were planted in peatmoss : perlite : agricultural soil medium (1:1:1 v/v basis) on 19.10.2009. The cuttings were maintained in the greenhouse till 10.5. 2010. Final data was collected at the end of the experimental period. Average temperature and humidity maintained under greenhouse conditions during October, 2009 – May, 2010 is detailed in Table 1.

Data Analysis.

The data on rooting percentage in various treatments were arcsine transformed before performing ANOVA [16]. For arcsine transformation of data in the cell A1, =

Table 1. Average temperature and humidity recorded in the greenhouse during the experiments.

Month	Average Temperature (°)	Average Humidity (%)
October	28	24
November	24	70
December	25	52
January	26	45
February	25	48
March	27	41
April	30	40
May	35	38

Plate 1. Rooting in semi hard wood cuttings of *capparis spinosa:* rooting density and length is not focused in this study and the above illustrations are just few examples of rooting in *Capparis spinosa*.

ASIN (SQRT(A1) command was used in a separate cell (B1). The data were analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test to ascertain the significant differences among treatments using SPSS software [17]. The mean values for each treatment was back transformed and presented in the Table 2. To back transfer the data and the formula used was =(SIN(B1))^2.

RESULTS

Semi hardwood cuttings treated with 400 ppm IBA resulted in highest rooting percentage of 79.39% followed by 400 (75%) and 200 ppm (65.45%) NAA (Plate 1). It was observed that, increase in the concentration of IBA from 100 to 400 ppm, increased the rooting percentage of the cuttings. Interestingly, treatment with 100 and 400 ppm NAA had the same effect on the rooting while treatment with 1000 ppm IBA and NAA was found to inhibit the rooting of cuttings. Detailed results for various treatments are illustrated in Table 2.

DISCUSSION.

In some plants, adventitious root formation initiated without any treatment, while others would require different growth regulators, usually auxin [18]. Auxin induces root formation by breaking root apical dominance induced by cytokinin [19]. IBA is widely used because it is nontoxic to most plants over a wide range and promotes root growth in a large number of plant species [20].

Table 2. Effect of growth regulators (quick dip method) on rooting of hardwood cuttings of *Capparis spinosa.*

Treatment [v]	Mean Rooting Percentage
100 ppm IBA[i]	4.32 [a] ± 0.37 [iv]
200 ppm IBA[ii]	20.61 [ab] ± 0.10
400 ppm IBA	79.39 [c] ± 0.12
1000 ppm IBA	9.55 [a] ± 0.30
100 ppm NAA[iii]	65.45 [bc] ± 0.24
200 ppm NAA	39.61 [abc] ± 0.24
400 ppm NAA	75.00 [bc] ± 0.12
1000 ppm NAA	29.67 [abc] ± 0.12
Control	4.32 [a] ± 0.34
Significance	**

i-The means followed by the same letter are not statistically different at p 0.01.
[ii] IBA- Indole Butyric Acid, [iii] NAA - Naphthalene Acetic Acid, [iv] – Standard Error
[v]- Cuttings were treated hormones using quick dip method.
** = Significant at P ≤ 0.01 levels.

Howard found that different IBA concentrations were optimal for different species [21]. Gill and Chitkara found that the basal peach cuttings gave higher rooting percentages especially when treated with IBA [22]. Fujii and Nakano concluded that IBA and NAA had root promoting effects on the hardwood cuttings of Grapevine [23]. The results of the treatments used to stimulate rooting in cuttings showed the higher ability of auxins in generating adventitious roots in *Capparis spinosa*.

Caglar et al. [24] reported that utilization of indole-3-butyric acid IBA increases rhizogenesis of caper cuttings. The study results are in line with this finding. There was significant variation in rooting percentage when the cuttings were treated with 400 ppm IBA, 100, 400 ppm NAA when compared to control ($p \leq 0.01$). Among various concentrations of NAA, though the results from treatment with 100 and 400 ppm were better than 200 ppm, all the three treatments were not significantly different from each other. Study results of Soyler and Alslan also confirmed that the treatment with 250 ppm IBA resulted in 29% rooting only [6]. In our study, the treatment with 1000 ppm IBA resulted in poor rooting when compared to lower concentrations.

However, in contrast, the results of Gask *et al*. concluded that treatment with 6000 and 9000 ppm IBA enhanced the rooting percentage of *Capparis spinosa* to 67.1% and 61.4% respectively [25].

Cost of producing 1 litre of 400 ppm, 6000 ppm and 9000 ppm IBA and 100 ppm and 400 ppm NAA is US Dollars 0.898, 13.464, 20.196, 0.040, and 0.158 respectively. Cost of 400 ppm IBA is significantly cheaper than 6000 ppm and 9000 ppm IBA. Cost of one gram of IBA and NAA is calculated at US $ 2.24 and 0.40 respectively. This clearly indicated the importance of using alternate cheaper methods to enhance rooting in commercial vegetative propagation of caper. The cost of IBA and NAA was calculated based on the market price at Kuwait. In this study higher rooting percentage was achieved with lower concentrations of IBA and NAA.

CONCLUSION

The study results showed that treating the semi hardwood cuttings of *Capparis spinosa* with 400 ppm IBA, 100, 400 ppm NAA resulted in 79.39%, 65.45% and 75% respectively. Previous studies on cuttings of various species conclude that the effectiveness of auxin hormone applications in promoting rooting is influenced by hormone concentration, application methods, comparative effectiveness of different synthetic auxins and time of year when applications are made [26].

Rooting length, density in various treatments and effect of the period of study on rooting is not considered in this study. It is essential to conduct further research on these aspects of vegetative propagation of Caper in Kuwait's climatic conditions to exploit the possibility of mass propagation of Caper for utilization in urban landscaping and range land rehabilitation.

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