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# Effect of Growth Regulators on Rooting of Hardwood Cuttings of *Lycium shawii*, *Nitraria retusa* and *Farsetia aegyptia*

M. K. Suleiman, N. R. Bhat, S. Jacob and R. R. Thomas

*Arid land Agriculture and Greenery Department, Kuwait Institute for Scientific Research, P.O. Box 24885, Safat 13109, Kuwait*

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**Abstract:** Utilization of native plants in urban landscaping can potentially support their conservation and safeguard endangered native species from extinction. In this study, efforts were made to standardize vegetative propagation techniques for *Lycium shawii, Nitraria retusa* and *Farsetia aegyptia*. Effects of varying concentrations of rooting hormones on the success of rooting of hardwood cuttings of these species were studied in this research. Rooting in hardwood cuttings of *Lycium shawii* was enhanced (100%) by treating them with 1,000 ppm IBA, Ormone radicante in polvere (5,000 ppm NAA) and hormex (1,000 ppm IBA). Treatment with 1,000 ppm NAA was found to be effective for *Nitraria retusa*, while marginal success was recorded in rooting of hardwood cuttings of *Farsetia aegyptia* when treated with 400 ppm NAA. Rooting in untreated cuttings was 80%.

**Key words:** Urban landscape, vegetative propagation, species conservation, growth hormones, NAA, IBA, and $GA_3$.

## 1. Introduction

Many native plants of Kuwait have potential for use as animal fodder and sand protector from erosion, and in phytoremediation and ornamental landscaping. In addition to their contribution to the integrity of the environment, native plants are invaluable sources of useful genes for genetic improvement of crop plants [1]. Such perennial native plant genotypes need to be preserved and propagated on a large scale for rehabilitation and restoration of Kuwait's desert ecosystem [2]. The climate of Kuwait is characterized by extremely hot summer, with daytime temperature exceeding 50 °C and winter, cooler and at times wet, with temperature sometimes falling below 4 °C [3]. Native soil in Kuwait is mostly sandy in texture and calcareous in nature. The mean annual rainfall is 113 mm [4]. Indigenous plant species have evolved and adapted to the local harsh climatic conditions over the years, and they are more likely to function adequately under the local climate as opposed to exotic plants. Utilizing native plants in urban landscape projects can conserve the plant and allow more research on their propagation and cultural practices of these plants. Propagation techniques through tissue culture technology for native plants like *Rhanterium epapposum, Ochradenus baccatus, Nitraria retusa* and *Lycium shawii* were developed because of their potential for use in urban landscaping and in desert revegetation [5]. 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

M. K. Suleiman, B.Sc., certified desert landscaper, research scientist, KISR, research fields: landscaping and horticulture. E-mail: mkhalil@kisr.edu.kw.

**Corresponding author:** S. Jacob, M.Sc., research technician, KISR, research field: agriculture. E-mail: sjacob@kisr.edu.kw.

as this method ensures true-to-type seedlings; as well as it develops seedlings at a faster rate for further utilization. The potential of vegetative propagation for the bulking up of genetically desired plants within a short period has been demonstrated for tree species by several researchers [5-8]. This technique is simpler for adoption by the nursery laymen for future mass propagations. Many asexual techniques of propagation are extensively used by the horticulturist to produce quality planting materials in perennial and woody perennial plants [9]). In some plants, adventitious root formation initiate without any treatment, while others required different growth regulators usually auxin [10]. Auxin induces root formation by breaking root apical dominance induced by cytokinin [11]. Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) are synthetic rooting chemicals that have been found to be reliable in the promotion of rooting in cuttings more proficiently than Indole Acetic Acid (IAA) which is a native auxin [12]. IBA is widely used because it is non-toxic to most plants over a wide range and promotes root growth in a large number of plant species [13]. Howard [14] found that different IBA concentrations were optimal for different species. Application of gibberellins generally has little or negative effect on root growth. However it has been reported that cuttings from $GA_3$-treated citrus trees achieved higher percentage rooting than untreated ones [15]. In contrast, $GA_3$ application to leaf cuttings of *Lycopersicum esculentum* Mill. inhibited root regeneration and starch accumulation [16].

Though various studies have been performed at Kuwait Institute for Scientific Research (KISR) on native plant propagation; the techniques used were not standardized for mass propagation and utilization. Literature study indicated that there are no previously published reports on mass propagation of these species. Hence, this study investigates the possibility of vegetative propagation via hardwood cuttings. Vegetative propagation of *Lycium shawii, Nitraria retusa* and *Farsetia aegyptia* through hardwood cuttings and the effect of varying concentrations of rooting hormones on the success of rooting were studied in this research.

*Lycium shawii* is a thorny native perennial shrub that belongs to the *Solanaceae* family. It grows along sandy stone ridges. It has purple, sometimes white, trumpet-like flowers and sharp thorns. The leaves are elliptical and congested in closed clusters [4]. The flowers are produced during March to April in its natural environment and throughout the year in irrigated soil. The fruits are globular, many seeded, red to orange berries which are edible and somewhat sweet. It provides honey for wild bees and food and shelter for wild birds and animals [2].

*Nitraria retusa* (Forssk.) Asch. is one of the native perennial species that belong to the botanical family *Zygophyllaceae*. It grows along the shallow sand hummocks on saline ground near the coastal areas. It is a thorny shrub with fleshy, grayish, heart-shaped leaves [2]. It is a salt-tolerant and drought-resistant species which produces fleshy red fruits [4]. The fruits are tasty, and a refreshing juice may be extracted from them. Many wildlife forms feed on the fruits and leaves of this plant. The natural propagation of this species is through seeds.

*Farsetia aegyptia* Turra. is one of the native perennial species in the *Cruciferae* family. It is of fodder value and has potential to adapt to urban landscape conditions where several exotic species are now being used. It is a grey green, woody perennial about 30 cm high. It has slender, smooth and multi-branched stems. The flowers are creamy brown with four petals. Two rows of seeds are formed in an oval-shaped seed pod. It flowers during April and the natural propagation is through seeds [4]. *Farsetia aegyptia* is now an exceedingly rare perennial in Kuwait's desert.

## 2. Materials and Methods

### *2.1 Plant Material*

Hardwood cuttings of *Lycium shawii* and *Farsetia aegyptia* were collected from Sulaibiya (Kuwait desert)

area (N 29°8′42.3″, E 47°40′59.2″) on November 11, 2008. *Nitraria retusa* cuttings were collected from Benaider (N 28°46′34.1″, E 48°17′40.6″) on November 18, 2008.

*2.2 Treatment Details*

Vegetative stem cuttings were dipped in freshwater before treating them with different concentrations of indole butyric acid (IBA), naphthalene acetic acid (NAA) or gibberellic acid ($GA_3$). Collectively, there were 11 treatments, replicated five times. A total of 165 hardwood cuttings of *Lycium shawii, Farsetia aegyptia* and Nitraria *retusa* were used to test 11 treatments in a randomized complete block design with five replications of three cuttings each ($11 \times 5 \times 3 = 165$). Quick dip method was used to treat the cuttings with rooting hormones. Following the treatment, vegetative cuttings were planted in perlite medium. Commercial hormones like Ormone radicante in polvere (reginal P) with 5,000 ppm NAA, Pokon (2,500 ppm IBA) and Hormex (1,000 ppm IBA) were used in this experiment. All the other concentrations of NAA (400 and 1,000 ppm), IBA (1,000 and 2,000 ppm) and $GA_3$ (500, 750 and 1,000 ppm) were prepared in the lab. The experiments were conducted from 14.12.08 to 29.3.09. Average temperature and humidity maintained under greenhouse conditions during November – March is detailed in Table 1.

The data were analyzed using R analysis procedure of Analysis of Variance (ANOVA) and Dunkan's Multiple Range Test to ascertain the significant differences among treatments [17, 18].

## 3. Results and Discussion

*3.1 Lycium Shawii*

Hundred percent cuttings of *Lycium shawii* treated with 1,000 ppm IBA, Ormone radicante in polvere (5,000 ppm NAA) and hormex (1,000 ppm IBA) resulted in rooting (Fig. 1). Treatment with 2,000 ppm IBA, 400 ppm NAA and Pokon also produced rooting in 93.33% of cuttings. Eighty percent of untreated cuttings of *Lycium shawii* also resulted in rooting (Table 2).

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

| Month | Average temperature (°C) | Average humidity (%) |
|---|---|---|
| November | 28.5 | 23 |
| December | 29 | 26 |
| January | 27 | 30 |
| February | 25.8 | 50.2 |
| March | 26.5 | 40.83 |

**Fig. 1 Rooting in cuttings of *Lycium shawii*.**

Results indicate that increase in the concentration of IBA decreases the percentage of rooting. Though increase in the concentration of lab prepared NAA resulted in a decrease in rooting of cuttings, commercial NAA like Ormone radicante in polvere with higher concentration (5,000 ppm) exhibited better rooting (100%). Ormone radicante which is in powder form is also easy to use and effective in promoting rooting. Treatment with various concentration of $GA_3$ (500, 750 and 1,000) had a negative effect on rooting of *Lycium shawii* cuttings.

*3.2 Nitraria Retusa*

Maximum rooting percentage (Fig. 2) was obtained in cuttings treated with 1,000 ppm IBA (26.66%), followed by 400 ppm NAA (20%) and hormex (13.33%).

**Table 2 Effect of growth regulators on rooting of Hardwood cuttings of *Lycium shawii, Nitraria retusa* and *Farsetia aegyptia.***

| Treatment | Rooting (%) | | |
|---|---|---|---|
| | *Lycium shawii* | *Nitraria retusa* | *Farsetia aegyptia* |
| 1,000 ppm IBA[b] | 100 b[a] | 26.67 c ± 6.65 | 6.67 ab ± 6.67 |
| 2,000 ppm IBA | 93.33 b ± 6.65 | 6.67 ab ± 6.65 | 0 |
| 400 ppm NAA[c] | 93.33 b ± 6.65 | 20 bc ± 8.15 | 13.33 b ± 8.16 |
| 1,000 ppm NAA | 86.67 b ± 8.15 | 0 | 0 |
| 500 ppm $GA_3$ | 40.00 a ± 6.65 | 6.67 ab ± 6.65 | 0 |
| 750 ppm $GA_3$ | 40.00 a ± 12.45 | 0 | 0 |
| 1,000 ppm $GA_3$ | 46.67 a ± 8.15 | 0 | 0 |
| Ormone radicante in polvere (Rigenal P) with 0.5 g NAA | 100.00 b | 0 | 0 |
| Pokon (IBA) | 93.33 b ± 6.65 | 6.67 ab ± 6.65 | 0 |
| Hormex (IBA) | 100.00 b | 13.33 abc ± 8.15 | 0 |
| Control | 80.00 b ± 13.31 | 0 | 0 |
| Significance | *** | ** | * |

[a] The means followed by the same letter are not statistically different at $P \leq 0.01$.

[b] IBA-Indole Butryric Acid, [c] NAA-Naphthalene Acetic Acid, *, **, *** = Significant at $P \leq 0.1, 0.01, 0.001$ levels.

**Fig. 2 Rooting in cuttings of *Nitraria retusa.***

**Fig. 3 Rooting in cuttings of *Farsetia aegyptia.***

### *3.3 Farsetia Aegyptia*

Only 13.33% of rooting (Fig. 3) was obtained in the cuttings of *Farsetia aegyptia* that were treated with 400 ppm NAA. Most of the other treatments did not have any effect on the rooting of cuttings.

Percentage of success in rooting was less in *Nitraria retusa* and *Farsetia aegyptia*. The rooting percentage was analyzed using SPSS and R analysis procedure, which showed that there was significant difference in the rooting percentage in *Lycium shawii* and *Nitraria retusa* among various treatments indicating importance of the study results.

Gill and Chitkara [19] found that the basal peach cuttings gave higher rooting percentages especially when treated with IBA (1,000 ppm). Fujii and Nakano [20] concluded that IBA and NAA had root promoting effects on the hardwood cuttings of Grapevine. Tsipouridis et al. [12] stated that $GA_3$ was negatively

related to rooting while IBA 2,000 ppm significantly increased rooting in peach hardwood and semi hardwood cuttings. This inhibition of rooting by $GA_3$ may be a direct, local effect [21]. Haissig [22] concluded that in brittle willows (*Salix fragilis* L.), applied $GA_3$ blocked the action of auxin in pri-mordium development, subsequent to the initiation phase. Though gibberellin enhances root formation in several species and under certain environmental conditions [23, 24], the results of the present study showed that $GA_3$ inhibited root growth in *Lycium shawii* cuttings which is also supported by earlier research in other species. Previous studies on cuttings of various species concluded that the effectiveness of auxin hormone applications in promoting adventitious root formation in cuttings is influenced by hormone concentration, application methods, comparative effectiveness of different synthetic auxins and time of year when applications are made [25]. In the absence of previous research on vegetative propagation of *Nitraria retusa* and *Farsetia aegyptia*, the future studies should concentrate on the above mentioned factors. This study was successful in standardizing vegetative propagation technique for *Lycium shawii*.

## 4. Conclusions

Standardization of vegetative propagation techniques is necessary for initiating the commercial production of Kuwait's native plants in nurseries. Utilization of native plants in urban landscaping can potentially support its conservation and safeguarding endangered native species from extinction thus promoting their sustainability in that region. One hundred percent rooting in hardwood cuttings of *Lycium shawii* was obtained by treating them with 1000 ppm IBA, Ormone radicante in polvere (5,000 ppm NAA) and Hormex (1,000 ppm IBA). Treatment with 1,000 ppm NAA was found to be effective for *Nitraria retusa*, while marginal success was recorded in hardwood cuttings of *Farsetia aegyptia* when treated with 400 ppm NAA.

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