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Cutting Propagation Studies in *Pennisetum divisum* and *Tamarix aucheriana* as Native Plant Species of Kuwait

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***Abstract*—**Native plants are better adapted to the local environment providing a more natural effect on landscape projects; their use will both conserve natural resources and produce sustainable greenery. Continuation of evaluation of additional native plants is essential to increase diversity of plant resources for greenery projects. Therefore, in this project an effort was made to study the mass multiplication of further native plants for greenery applications. Standardization of vegetative propagation methods is essential for conservation and sustainable utilization of native plants in restoration projects. Moreover, these simple propagation methods can be readily adapted by the local nursery sector in Kuwait. In the present study, various treatments were used to mass multiply selected plants using vegetative parts to secure maximum rooting and initial growth. Soft or semi-hardwood cuttings of selected native plants were collected from mother plants and subjected to different treatments. *Pennisetum divisum* can be vegetatively propagated by cuttings/off-shoots. However, *Tamarix aucheriana* showed maximum number of rooted cuttings and stronger vigor seedlings with the lowest growth hormone concentration. Standardizing the propagation techniques for the native plant species will add to the rehabilitation and landscape revegetation projects in Kuwait.

***Keywords*—**Kuwait desert, landscape, rooting percentage vegetative propagation.

I. Introduction

DESERTIFICATION and species extinction are adversely affecting the biodiversity conservation in many countries, including the state of Kuwait. Several native perennial plant species in Kuwait and the Arabian Peninsula are threatened, endangered, or even difficult to propagate.

Adding more ornamental plants to the greenery plant list in Kuwait is crucial to enhance urban and suburban aesthetic value, most of these introduced plants are consuming high amount of water and continuous maintenance to withstand the hot, arid conditions in Kuwait; hence using native plants in greenery could sustainably serve the goal of diversity and conservation.

The arid ecosystems of the world can support plants that have minimum water requirements and are drought-and salt-tolerant, to be used in afforestation, landscaping, and gardening projects, as drought has always been a normal recurrent event in arid and semiarid lands [1]. In addition to their contribution to the integrity of the environment, plants are invaluable sources of useful genes for the genetic improvement of crop plants [2]. Shrubs specifically are significant desert rangeland vegetation and have the potential to be utilized in the urban landscape [3].

Due to the limited and rapidly declining natural water resources in Kuwait and the expensive desalinated water, the present practice of using water-thirsty exotic ornamental plants for greenery development is not practical and sustainable in the long-term. Since native plants are better adapted to the local environment, they tolerate long spells of drought and high soil salinity levels, their use in landscape will add to natural conservation and sustainability. It is essential to increase the plant palette of greenery in Kuwait by incorporating native plants in landscape projects; there is an urgent need to mass multiply the proven native plants for their large-scale use. Hence, this study was aimed at standardization of effective mass multiplication techniques of *Pennisetum divisum* and *Tamerix aucheriana* using vegetative parts through various treatments to ensure maximum propagation.

II. Methodology

Semi-hardwood cuttings of *Pennisetum, divisum,* and *Tamerix aucheriana* were collected from mother plants and were planted in perlite substrate after treating them with rooting hormones in quick dip method. Stem cuttings *Pennisetum divisum* with 2–3 nodes were collected from the Agricultural Research Station, Sulaibiya (desert area). Semi-hardwood cuttings of *Tamerix aucheriana* with 8-10 buds were collected from Benaider (coastal area) and were treated with varying concentrations of indole butyric acid (IBA) (100, 200, 400 and 5000 ppm) or naphthalene acetic acid (NAA) (100, 200, 400, 1000 and 1500 ppm) and a commercial hormone [(Ormone radicante in polvere (Rigenal P) (0.5% NAA))]. Control cuttings were dipped in water or in water: alcohol (50:50). Each treatment was replicated five times and was planted in a completely randomized block design and maintained in the greenhouse (Total 120 cuttings).

Data Collection and Analysis

Observations on rooting percentage, vigor of the seedlings from cuttings (1-5, with 5 being the maximum), height, number of leaves/branch, as well as root and shoot biomasses were recorded at the termination of the experiment.

The data on rooting percentage, and biomass were analyzed using Analysis of Variance (ANOVA) procedure and Duncan's Multiple Range Test to ascertain the significant differences among treatments using IBM® SPSS® software of version 22 [4]. Nontransformed data of rooting percentage are presented

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in Tables I and II.

III. Results and Discussions

A. Pennisetum divisum

Rooting was observed in all treatments, however, the rooting percentage varied. Untreated stem cuttings of *Pennisetum divisum* resulted in 70% rooting. Figs. 1-3 show steps of the experiment. Increase in the concentration of IBA and NAA reduced the success rate of rooting (Table I). Growth hormones at the lower concentration (100 ppm IBA and 200 ppm NAA) produced higher rooting percentage comparable to control. Maximum number of untreated cuttings rooted and treatment with 100 ppm NAA produced highest number of vigor five seedlings.

Fig. 1 Potted *Pennisetu*m cuttings

Fig. 2 Root system of *Pennisetum divisum*

Fig. 3 Healthy and uniform *Pennisetum* plants

TABLE I
EFFECT OF GROWTH REGULATORS ON ROOTING OF STEM CUTTINGS OF *PENNISETUM DIVISUM*

	Treatment	Vigor (%)					Rooting %	Root Bio mass (g)	Shoot Bio mass (g)	No. of Leaves	Plant Height (cm)
		1	2	3	4	5					
1	100-ppm IBA[i]	0	0	0	0	60	60	20.3^{abc}	28.7	15.7^{abc}	70.0^{bc}
2	200-ppm IBA	0	0	0	40	10	50	19.7^{bc}	29.3	16.7^{ab}	66.7^{cd}
3	400-ppm IBA	0	0	0	10	0	10	20.3^{abc}	31.7	9.3^{de}	56.0^{ef}
4	5000-ppm IBA	0	0	10	10	0	20	19.0^{c}	27.7	12.3^{bcd}	55.0^{f}
5	100-ppm NAA[ii]	0	0	10	20	20	50	20.3^{abc}	29.7	7.0^{e}	43.0^{g}
6	200-ppm NAA	0	0	30	40	0	70	19.0^{c}	28.7	11.0^{cde}	59.3^{ef}
7	400-ppm NAA	0	0	0	40	0	40	19.7^{bc}	28.7	17.0^{ab}	71.0^{bc}
8	1000-ppm NAA	0	0	10	20	0	30	19.7^{bc}	29.3	18.3^{a}	62.7^{de}
9	1500-ppm NAA	0	0	10	20	0	30	20.3^{abc}	29.3	10.0^{de}	62.7^{de}
10	Ormone Radicante in Polyvere (Rigenal P) (5000 ppm NAA)	0	0	0	30	0	30	20.7^{abc}	28.3	12.0^{bcde}	57.0^{ef}
11	Control with alcohol (50% alcohol)	0	0	10	20	10	40	21.7^{a}	30.7	20.0^{a}	85.3^{a}
12	Control	0	0	0	40	30	70	21.3^{ab}	30.3	19.3^{a}	74.3^{b}
	Significance						NS	*	NS	**	**

V5: Excellent; V4: Very Good; V3: Moderately Good; V2:Average; V1: Poor.

Control cuttings also produced taller seedlings with highest number of leaves and root biomass. There was a significant difference among the rooting percentage of seedlings, root biomass, number of leaves, and final height of the seedlings of the control cuttings, compared to the treated cuttings (Table I). Hence, it is suggested to propagate the *Pennisetum divisum* vegetatively without any treatment.

B. Tamerix aucheriana.

Treatment with 100 ppm IBA produced maximum number of rooted cuttings and vigor five seedlings. However, there was no significant variation among the treatments in rooting percentage, root biomass, number of branches, and final height of the plant. The plants ready for the experiment is shown in Fig. 4. Cuttings treated with 1500-ppm NAA produced maximum shoot biomass, and the results significantly varied with the results from other treatments (Table II). Treatment with 100-ppm IBA is suggested in order to obtain maximum rooting percentage in *Tamarix aucheriana*. Fig. 5 shows the rooting system developed with 100-ppm IBA treatment. Fig. 6

shows the variance in plant growth under different treatments.

Fig. 4 Potted *Tamarix* cuttings

IV. CONCLUSION

Certain plants produce roots from cuttings without any treatment; while others would require some growth regulators to initiate rooting. Rooting hormone can stimulate a plant cutting to begin sending new roots out of a stem node. Reference [5] studied the effect of auxin group hormones indole acetic acid (IAA), IBA, and NAA in *Melissa officinalis* on stem cuttings and reported that these hormones do not have an apparent effect on rooting percentage; however, these hormones affect root generation. Reference [6] reported that cuttings of certain ornamental plants could be rooted by spray treatments of cuttings with IBA concentrations. Due to the fact that IBA is commonly known as nontoxic hormone, it is widely used to promote root growth [7]. IBA and NAA proved their ability in improving rooting of *Capparis spinosa* in semi-hardwood cuttings [8]. IBA of 500 ppm is most effective in the stimulation of root system arising from cutting and development of roots of *Citrus auriantifolia* cutting, which can be used for mass scale multiplication [9]. Reference [10] repeated application of IBA in 2500 to 4000 mg/l and generated impressive results in rooting the semi-hardwood cuttings in apple, plum, and olives. *Pennisetum divisum* can be vegetatively propagated by cuttings, and showed good performance without any treatments. In *Tamarix aucheriana*, treatment with 100-ppm IBA produced maximum number of rooted cuttings and vigor five seedlings. Hence, treatment with 100-ppm IBA is suggested to obtain maximum rooting percentage in *Tamarix aucheriana*.

Fig. 5 Root system of *Tamarix aucheriana*

Fig. 6 Healthy *Tamarix* plants

TABLE II
EFFECT OF GROWTH REGULATORS ON ROOTING OF STEM CUTTINGS OF *TAMARIX AUCHERIANA*

	Treatments	Vigor (%)					Rooting (%)	Root Biomass (g)	Shoot Bio mass (g)	No. of Leaves	Final Height (cm)
		1	2	3	4	5					
1	100-ppm IBA[i]	0	0	0	27	33	60	21.3	29.0^{bc}	4.7	28.0
2	200-ppm IBA	0	0	0	20	7	26	21.0	31.3^{ab}	9.3	25.7
3	400-ppm IBA	0	0	20	20	7	33	21.3	30.7^{abc}	10.0	24.0
4	5000-ppm IBA	0	0	13	7	0	20	20.3	30.3^{abc}	10.0	27.0
5	100-ppm NAA[ii]	0	0	0	33	7	40	19.3	31.0^{abc}	7.7	28.7
6	200-ppm NAA	0	0	0	13	7	20	18.7	28.0^{c}	9.0	25.0
7	400-ppm NAA	0	0	7	33	0	40	21.0	31.7^{ab}	8.3	20.3
8	1000-ppm NAA	0	0	7	33	7	47	19.7	29.7^{bc}	11.7	26.0
9	1500-ppm NAA	0	0	7	33	0	4	21.0	33.0^{a}	18.3	22.0
10	Ormone Radicante in Polyvere Rigenal P) (5000-ppm NAA)	0	0	0	20	7	27	20.3	29.0^{bc}	7.0	20.0
11	Control (50% alcohol)	0	0	0	33	13	47	20.7	29.0 bc	9.3	22.0
12	Control	0	0	0	33	6.6	40	21.0	28.0 c	12.7	23.0
	Significance						NS	NS	*	NS	NS

V5: Excellent; V4: Very Good; V3: Moderately Good; V2:Average; V1: Poor.

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