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SCHOLARLY, PEER REVIEWED

Volume 25 No. 8
September 2025

PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2025; 25(8): 27591-27605 https://doi.org/10.18697/ajfand.145.25675

Date	Submitted	Accepted	Published
	20th December 2024	29th May 2025	3rd October 2025

UNRAVELLING THE ROOTING RESPONSE OF THE UNDERUTILIZED WILD HERB, *DASISPERMUM SUFFRUTICOSUM (P.J. BERGIUS) B.L. BURTT*, IN RESPONSE TO GROWTH MEDIA AND IBA TREATMENT

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Volume 25 No. 8
September 2025
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ABSTRACT

Dasispermum suffruticosum, is an underutilized wild herb found on the sandy coastal dunes along the East to West Coast of South Africa. It is commonly known as sea parsley in English or "duineseldery" in Afrikaans. The lack of literature in its production and use has resulted in its underutilization. This research generated a pre-liminary investigation on the effects of different formulations of rooting media and indole-3-butyric acid (IBA) treatment on the vegetative propagation of *D. suffruticosum* as influenced to establish a viable asexual propagation protocol for imminent cultivators of the species. Nodal stem cuttings of *D. suffruticosum* were obtained from a selected plant population growing along the coast at the Walkerbay Nature Reserve, Stanford, South Africa. Stem cuttings of about ±15 cm long with a stem thickness of approximately 8 mm were treated with different concentrations of a commercial growth regulator Makhroroot™ (containing 0.1% IBA for 1 softwood, 0.3% for 2 semi-hardwood and 0.8% for 3 hardwood) and planted into four different rooting media: sand (S), sand: peat (SP) (1:1), perlite: peat (PP) (1:1) and peat: perlite: vermiculite (PPV) (1:1:1). The results showed non-significant differences in rooting percentage, callus production, and other growing parameters across the different rooting media, IBA treatments, and their interaction. Cuttings placed in sand with IBA treatments M1 and M2 exhibited the best results in the variables assessed. Although this study showed that sea parsley does not require alternative growing media and requires low concentration of growth regulators for rapid root initiation and multiplication, it is imperative to note this cultivation technique for its potential to significantly contribute to food security and promote healthy diets for both rural and urban households, given its nutritional and pharmaceutical benefits. The opportunity of using sand could be a cost-saving option for potential growers of the species, who may want to exploit this plant for diet diversity and as a source of nutritional substitute for parsley and celery. Furthermore, the outcome of this study may provide a necessary protocol to produce the species, should the conservation status of the plant change for the species to be strategically adopted by South African growers for production.

Key words: coastal food, conservation agriculture, food security, nutrition, propagation, sea parsley

Citation: **Witbooi H and M Ngumla** Unravelling the Rooting Response of the Underutilized Wild Herb, *Dasispermum suffruticosum (P.J. Bergius) B.L. Burtt*, in Response to Growth Media and IBA Treatment. *Afr. J. Food Agric. Nutr. Dev.* 2025; **25(8):** 27591-27605. https://doi.org/10.18697/ajfand.145.25675

INTRODUCTION

Dasispermum suffruticosum (*P.J. Bergius*) B.L. Burtt, commonly known as sea parsley or dune celery, is an underutilized coastal wild herb that has potential for cultivation and commercial use. Its distribution is restricted to coastal dunes, limestone cliffs and rocky shores, and is a member of the Apacieae family, which is largely known to be rich in secondary metabolites and phytochemicals which are potential source of drugs such as coumarins, flavonoids, terpenoids, triterpenoid saponins, polyacetylenes, and steroids [1]. This study investigates the rooting response of *D. suffruticosum* using IBA growth regulators and different growing mediums. Rooting response studies are critical in determining how well a plant species can develop roots, which are required for growth and development [2]. The objective is to gain an insight into how these variables impact sea parsley root development, which could have conclusions for production practices, conservation efforts and industrial use. This study further provides useful understandings on enhancing the growth conditions for sea parsley and potentially increasing its use. It has finely distributed aromatic leaves, like the culinary favorite flat-leaf or curly leaf parsley, which form small clusters of white flowers. Sea parsley has both medicinal and culinary use. The leaves are used to flavor dishes, and the plant has valuable medicinal properties. Sea parsley is a good source of vitamins and minerals [3]. It contains vitamin C, which is critical for immune system function and skin health, as well as antioxidants that help fight oxidative stress in the body [4]. Traditional uses of sea parsley include its adoption in herbal medicine. It is believed to have diuretic properties and is used to treat conditions such as urinary tract infections. Additionally, it is used in some cultural cuisines as an aromatic herb and as a decoration for cooking [5].

In terms of environmental growth, sea parsley is well adapted to high light intensity, sandy conditions, harsh wind conditions, salt spray, high temperatures, low temperatures, humidity, and can endure being entirely buried in sandy in coastal environments that receive plenty of sunlight. Sea parsley typically grows in the warmer months and is often found in spring and summer. It grows along the South African coast, particularly in the sandy areas near the sea. It adapts well to salty and sandy soils, making it a resistant plant to harsh coastal conditions [6]. Sea parsley's deep root system helps stabilize sand dunes and prevent erosion along the coast. By anchoring the soil with its roots, sea parsley helps maintain the integrity of coastal habitats and protect them from the effects of wind and water erosion. Although parsley is not currently listed as a threatened species, conservation efforts to protect coastal habitats could indirectly benefit this plant and other species that rely on these ecosystems [7].

Indole-3-butyric acid (IBA) is a plant hormone commonly used as a rooting hormone in plant propagation. IBA promotes the growth and root development of seedlings and cuttings, allowing them to be established more effectively once new plants emerge. In addition to accelerating root formation, IBA is used in various crops to stimulate flower development and fruit growth. Rooting hormones containing IBA are often used by horticulturists to increase the rooting efficiency of plant cuttings [8]. The choice of growing medium depends on the type of plant being grown and its specific needs. A good growing medium provides a stable structure for root anchoring, allows for adequate aeration and drainage, and contains the nutrients necessary for plant growth. Despite the plants' natural ability to produce seeds, it poses to be a challenge to germinate in the wild and through sexual propagation. Several of our coastal sites have sparse plant populations and the seeds that have been collected for germination are being investigated to unlock seed dormancy in our research group. The objective of this study was to ensure healthy growth and development of sea parsley by selecting the right growing medium according to the plants' needs [9].

MATERIALS AND METHODS

The experiment was conducted in the semi-controlled environment at Landskein Wine Farm, located along the provincial route R43 in Stanford, Western Cape of South Africa. The experiment was carried out over a period of three months from July to September 2024. The cuttings were sprayed intermittently with water four times a day, a heating bed and environmental control with temperatures set to range from 21 to 26°C during the day and 12-18°C at night. The average humidity was maintained at 60-70% during the experimental period.

Cuttings of *D. suffruticosum* were harvested (Cape Nature Permit number: CN35-28-30733) from a selected plant population growing along the coast at Walkerbay Nature Reserve (34.44187° S, 19.32444° E) (Figure 2.1). Only cuttings taken using uniform methods, i.e., stem cuttings with about two-thirds of leaves removed, ±15 cm long with a stem thickness (diameter) of approximately 4 mm, were used for the experiment. The cuttings were treated by rinsing them in 0.1% Sporekil™ for protection against fungal infection. Subsequently, the cuttings were dipped in different concentrations of commercial rooting hormone Makhroroot™ (containing 0.1% IBA for 1 softwood, 0.3% for 2 semi-hardwood and 0.8% for 3 hardwood) for two seconds as the hormone treatment. Stem cuttings without hormone treatment were the controls. A total of 12 cuttings were allocated per treatment (36 cuttings) and replicated three times (108 cuttings total). The cuttings were immediately planted into four different rooting media: sand (S), sand and peat (SP) (1:1), perlite and peat (PP) (1:1) and peat, perlite and vermiculite (PPV) (1:1:1) arranged in a

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SCHOLARLY, PEER REVIEWED
Volume 25 No. 8
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PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

completely randomized design on a specialized propagation bed with heating cables/rod underneath at ±24°C.

Figure 2.1: Plant population of sea parsley along the coast at Walkerbay Nature Reserve, Stanford, Western Cape. (Photo: Hildegard Witbooi)

Data collection included rooting percentage, root length, number of roots, number of leaves and plant height per treatment after 72 days. All percentage data were subject to angular transformation (arcsin √X) and SE number data to square root transformation before analysis [10]. The experimental data were analyzed using one and two-way analyses of variance (ANOVA), and the Fisher's least significant difference was used to compare means at $p \leq 0.05$ level of significance between treatments. All calculations were done on the computer software program, JMP version 17.0.

RESULTS AND DISCUSSION

Rooting percentage

A two-way analysis of variance was conducted to determine the effects of growing media, IBA rooting hormone, and the interaction of growing media and IBA rooting hormone on the leaf of cuttings for sea parsley. The growing media had a non-significant effect on the rooting percentage at $p \geq 0.05$ (Fig. 3.1).

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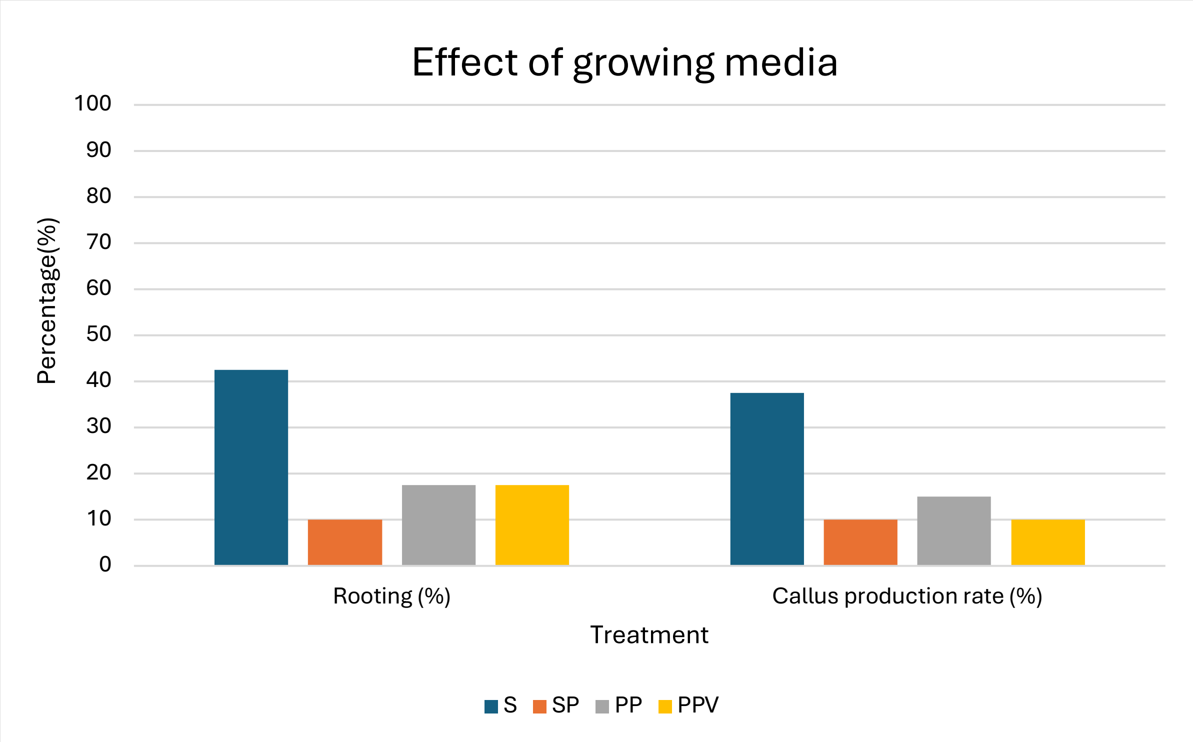

Figure 3.1: Effect of growing media on rooting percentage (%) and callus production rate (%) of sea parsley leaf cuttings. [S= Sand; SP= Sand: Peat; PP= Peat: Perlite; PPV= Peat: Perlite: Vermiculite]

A rooting percentage (42.5%) was recorded in S, followed by PP and PPV at (17.5%) (Fig. 3.1). The rooting hormone had a non-significant effect on rooting percentage (Fig 3.2), where M1 produced the highest rooting (45%), which did not differ from that obtained in M2 (40%) but differed significantly in M3 (0%) and the control (10%) (Fig. 3.2). Every cutting with M3 treatment did M3 did not sprout, resulting in 0% rooting (Fig. 3).

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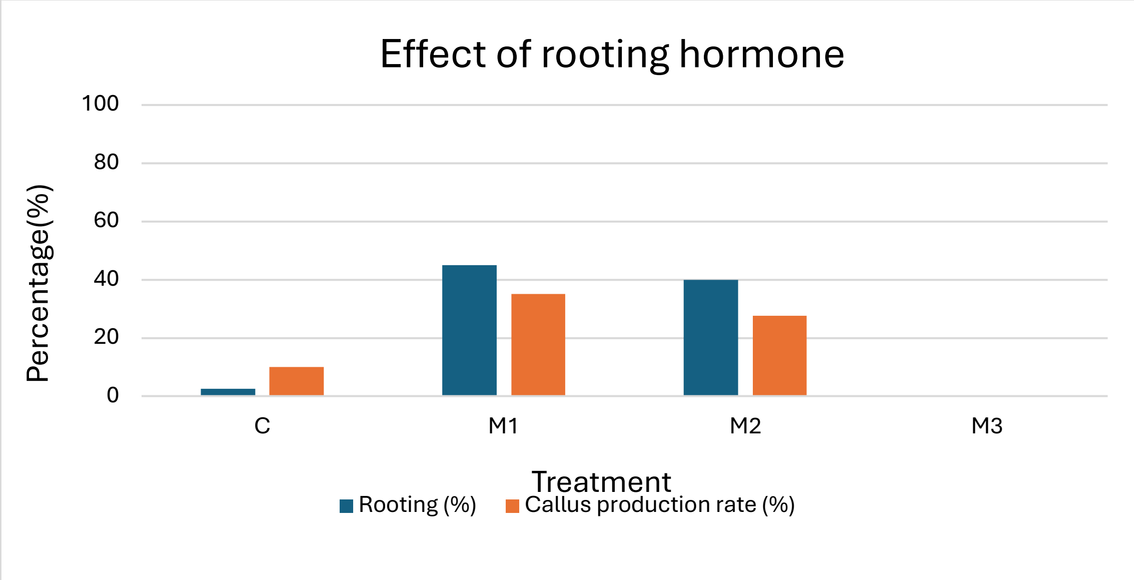

Figure 3.2: Effect of rooting hormone on rooting percentage (%) and callus production rate (%) of sea parsley leaf cuttings. [C= No rooting hormone; M1= Makhroroot 1; M2= Makhroroot 2; M3= Makhroroot 3]

The interaction of growing media and hormone treatment (Fig. 3.3) also had a non-significant effect on rooting percentage (Fig. 3.3). S.M1 (80%), and S.M2 (80%) had significantly higher rooting percentages compared to S (control) (10%), SP.M1 (30%), SP.M2 (10%), PP.M1 (40%), PP.M2 (30%), PPV.M1 (30%) and PPV.M2 (40%), respectively (Fig. 3.3).

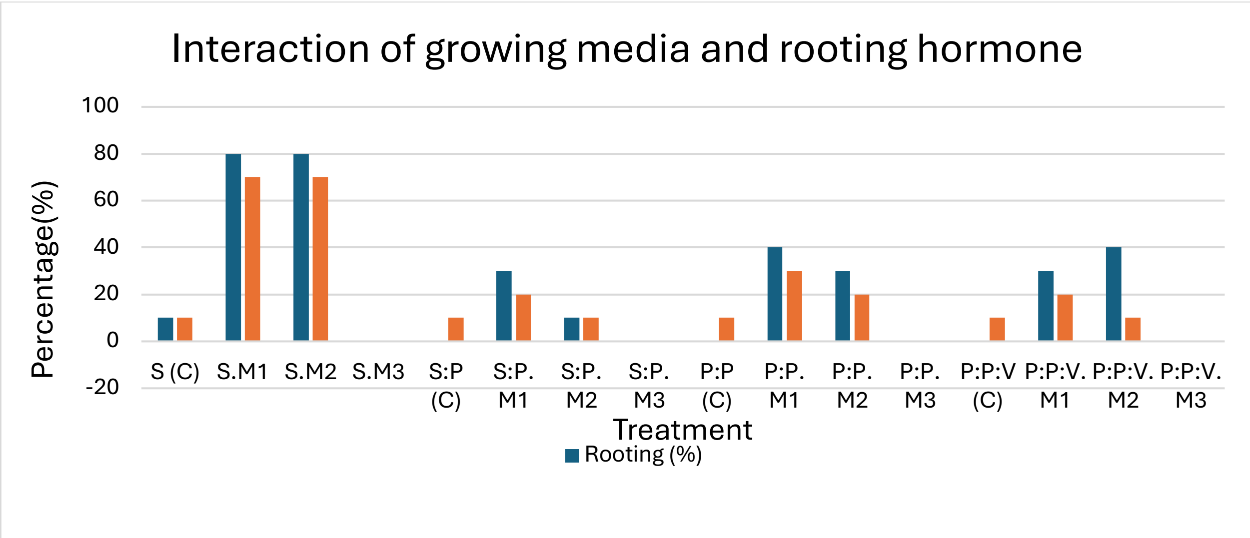

Figure 3.3: Effect of growing media and rooting hormone on rooting (%) and callus production rate of sea parsley leaf cuttings

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Rooting Length

The growing media (Fig. 3.4) had a non-significant difference (p≥0.05) in the root length. The longer root length was recorded in S at 0.58 cm, which was significantly different from SP (0.03 cm), PP (0.24 cm), and PPV (0.21 cm), respectively (Fig. 3.4). The rooting hormone (Fig. 3.5) had no significant effect on the root length, the longer root length was recorded in M1 at 0.575 cm, which did not differ significantly from C (0.25 cm) (Fig. 3.5). The interaction of growing media and rooting hormones also had no significant difference, S.M2 (9,7 cm). S.M3 and PPV.M3 resulted in no root formation and the recorded value (0 cm) (Figure 3.5).

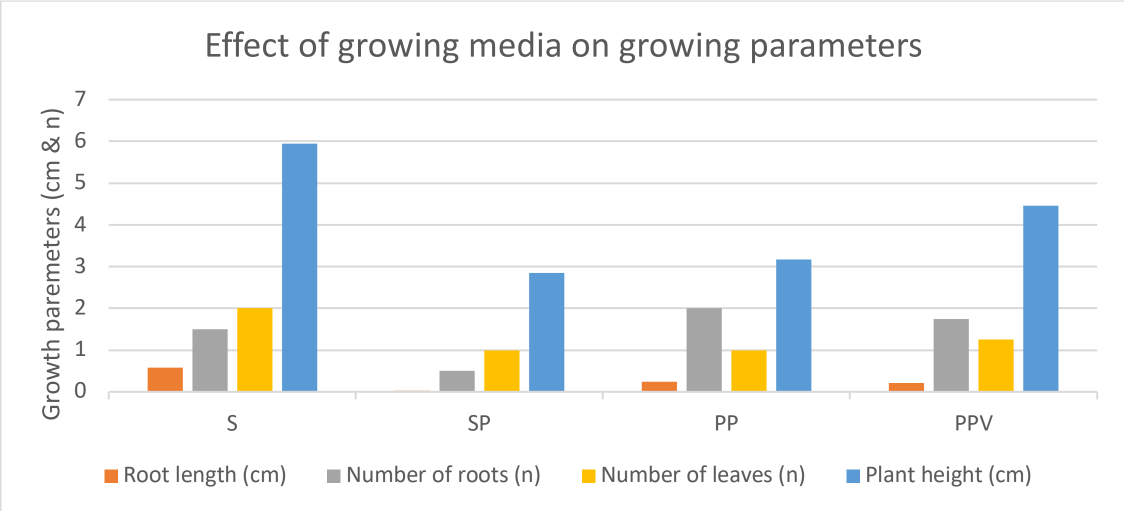

Figure 3.4: Effect of growing media on growth parameter of sea parsley leaf cuttings. [S= Sand; SP= Sand: Peat; PP= Peat: Perlite; PPV= Peat: Perlite: Vermiculite]

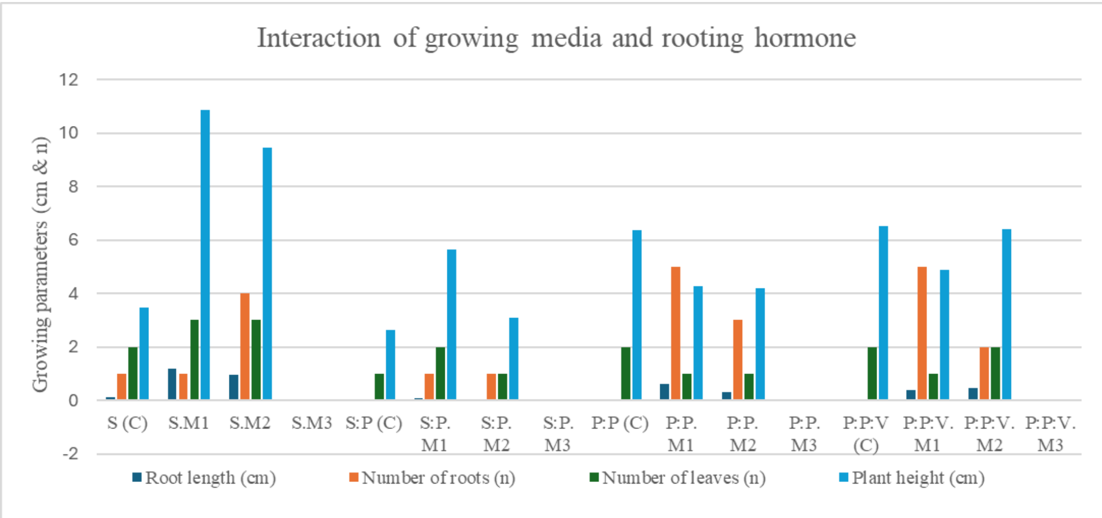

Figure 3.5: Effect of growing media and rooting hormone on root length, number of roots, number of leaves, and plant height of sea parsley leaf cuttings. [S= Sand; SP= Sand: Peat; PP= Peat: Perlite; PPV= Peat: Perlite: Vermiculite]

Number of roots

Growing media (Fig. 3.1), rooting hormone (Fig. 3.2), and the interaction of growing medium and rooting hormone (Fig. 3.3) produced a non-significant effect ($p \geq 0.05$) in the number of roots. The highest number of roots were recorded in PP (2) (Fig. 3.4), PPM2 (3), S.M2 (4), PP.M1 (5), PPV.M1 (5 cm) (Fig. 3.5), while the lowest were recorded in S.M3; SP.M3; PP.M3; PPV.M3, respectively (Fig. 3.5).

Number of leaves

The maximum number of leaves was recorded in S.M1 (3); and S.M2 (3), which did not differ significantly ($p \geq 0.05$) from those obtained in S.M3; SP.M3, PP.M3, and PPV.M3 respectively (Figure 3.5). The rooting hormone and its interaction with growing media had no significance ($p \geq 0.05$) on the number of leaves (Figure 3.5).

Plant height

The effect of growing media on plant height was non-significant ($p \geq 0.05$) (Fig. 3.4), the maximum height was recorded in S (5.95 cm), and this was not significantly different from that obtained in SP (2.84 cm); PP (3.17 cm) and PPV (4.46 cm), respectively (Figure 3.4). The interaction effect had no significant difference ($p \geq 0.05$) indicating that growing media and rooting hormone did not affect the height of the plant. The plant height in S.M1 was recorded as the highest mean value of height at (10.88 cm) while the lowest mean value was recorded in PPV.M3 (Figure 3.5).

Callus production rate (%)

The growing media had a non-significant effect on the callus production rate at $P \geq 0.05$ (Figure 3.1). A percentage of S at 37.50% (Fig. 3.1) was recorded followed by PP (15%), SP and PPV both at (10%) The rooting hormone had a non-significant effect on rooting percentage (Fig. 3.2), M1 produced the highest percentage (45%), which differed from that obtained in M2 (40%); M3 (0%), and C (0.25%) (Figure 3.2). The interaction effect of growing media and hormone treatment also had a non-significant effect on rooting percentage (Figure 3.3). S.M1 (80%), and S.M2 (80%) had significantly higher rooting percentages compared to S (control) (10%), S.M3 (0%); SP.M1 (30%); PP.M1 (40%), PP.M3 (0%) and PPV.M3 (0%), respectively (Fig. 3.3).

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SCHOLARLY, PEER REVIEWED
Volume 25 No. 8
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Figure 3.6: Rooted Sea parsley cuttings. A: S; B: PP; C: SP; D: PPV. [S= Sand; SP= Sand: Peat; PP= Peat: Perlite; PPV= Peat: Perlite: Vermiculite]. Treatments: [C= No rooting hormone; M1= Makhroroot 1; M2= Makhroroot 2; M3= Makhroroot 3]

Rooting medium

A growing medium is a substance through which plant roots grow and extract water and nutrients [11]. The study examined the effect of growing media and Indole-3-Butyric Acid (IBA) rooting hormone on sea parsley cuttings under a semi-controlled environment. Results showed that different media had no significant effect on plant growing parameters with the highest percentage in S (42.5%) (Fig. 3.6 A). The higher percentage rooting in S can be attributed to the fact that this is the plant's natural medium it thrives in. Compared to other media, S attributed lesser compaction and more aeration, and assisted in root formation and growth. Porosity and better aeration in sand might give momentum for the development of root structure [12]. Opposed to these findings, others relate to the amount of organic material, which also affects plant growth, survival, and many other attributes in the substrate [13], and a well-aerated media, which increases respiration at the base of the cuttings thus, promoting root initiation [14]. Poor rooting performance in peat, vermiculite and perlite mix might be caused by poor aeration since both peat and vermiculite have a high-water retention capacity. This led to delayed rooting and decaying of cuttings. Creating a good, and aerated environment will increase respiration at the base of the cuttings, similar to that of a rice husk growth medium, which enhanced rooting of *Vitellaria paradoxa* stem cuttings [14].

Rooting hormone

Auxin (IBA) play an important role in stimulating rapid root formation from cuttings of plants [15]. The application of IBA also showed no significant effect on the plant growing parameters. Treatment M1 yielded the highest percentage at 45%, but M3 and the control had significantly lower percentages. Every cutting in treatment M3 ceased, resulting in a rooting percentage of 0%. This is similar to a study where stem cuttings in *S. procumbens* [16] did not significantly increase the rooting and sprouting capacities, suggesting that auxins became toxic to plants at certain levels. Results of the current study are consistent with a study where the application of auxin at high concentrations can ineffectively promote or even inhibit the rooting and sprouting of cuttings [17].

Interaction of growing media and rooting hormone

The interaction between growing media and hormone treatment also showed no significant effect on rooting percentages. However, within specific combinations, such as S.M1 and S.M2, there were significantly higher rooting percentages (80%) compared to other treatments, including the control group (10%). In the results, the combination of S+M1 and S+M2 gave the highest survival, rooting percentage, root length, number of roots, and number of leaves, plant height, and callus production rate showing that it was the most suitable combination for cuttings of *D. suffruticosum*.

The rooting success in any cutting is affected by the interaction of a number of factors like water, oxygen, and nutrient availability in the growth media [18]. The effect of growth media on the rooting ability of stem cuttings of several economically important plants have been demonstrated by several works latest [19,20]. This study is similar yet contradicts that of the vegetative propagation by nodal stem cuttings of *Tetragonia decumbens*, a wild vegetable [21]. This may be caused by the plants deriving from different families. It may have distinct genetic makeups or different physiological traits (that is stress tolerance), which can lead to variations in their responses to treatments or environmental conditions.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The present study demonstrated that nodal stem cuttings of sea parsley may be propagated vegetatively for multiplication in sand with the use of growth hormones. Propagation in sand and further growing in this medium could be a cost-saving option for potential growers of the species. The plant has enormous potential to be exploited for diet diversity and as a source of nutritional substitute for herbs in cooking. Furthermore, its creeping nature, textured leaves and shy but idyllic flowers also makes it a potential ornamental plant in urban gardens, especially in areas where the soil lack nutrient and stability. The results suggest that while certain

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Volume 25 No. 8
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PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
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treatments (S.M1 and S.M2) led to a higher number of leaves, the differences were not statistically significant when compared to other treatments. This indicates that factors influencing leaf production may be more complex and not solely dependent on the type of growing media or rooting hormone used. Further investigation may be warranted to explore additional variables affecting leaf development in *Dasispermum suffruticosum.*

The apparent sparse growth on the Walkerbay Nature Reserve (Western Cape) and Boesmans Estuary (Eastern Cape) calls for some concern, despite its current listing of Least Concern in the SANBI Red Data Listing of South African plants [22]. The last entry was done in 2012, which suggests that the taxon may have to be reassessed. The scanty populations have some indication of a specific microclimate in its natural environment as a requirement for proliferation. Potential soil, microbiota and insect symbiosis requires further research, particularly since there was stink bug and other insect activity on the population sampled for this experiment. Further work may include future metabolomic effort in order to really dive into what allows the plant to survive in these conditions and the potential to tap into these mechanisms to apply in other noteworthy breeding programmes.

ACKNOWLEDGEMENTS

The work was supported by National Research Foundation (NRF), grant number TJ37, as well as grant number C461, Govan Mbeki Research and Development Center (GMRDC) and University of Fort Hare. The authors thank Mr. Tariro Masayiti for the experimental site. HW conceptualized, designed, setup, collected data, analyzed data, drafted the manuscript and acquired funding. MN assisted in field work, collected data, analyzed data and drafted the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare no conflict of interest.

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