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Differential growing media combined with indole butyric acid enhances the rooting and growth of Dragon fruit cladode cuttings under agro-climatic conditions of Faisalabad

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Abstract

The growth of dragon fruit is notably slow and limited due to various environmental, cultural, and biological factors. Poor drainage and waterlogged soil are the predominant causes, as the plant's shallow roots are particularly susceptible to rot in heavy or saturated media, hindering nutrient uptake and root development. It has flexible epiphytic characteristics and shallow root system requiring aeration. Therefore, this research focused on evaluating the impact of various growing media compositions combined with indole butyric acid (IBA) on the rooting and growth of dragon fruit cladode cuttings. The experiment had ten treatment combinations of growth medium combined with IBA, including a control, each replicated three times in a Randomised Complete Block Design (RCBD). Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm treatment exhibited higher survival rate, plant height, number of cladodes and cladodes length, number of roots, root length, root fresh weight, root dry weight and root volume attributes in dragon fruit cv. 'American Beauty' as compared to control treatment under agro-climatic conditions of Faisalabad, Punjab, Pakistan. In conclusion among treatments, Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm provide significant insights for enhancing dragon fruit production, assisting commercial growers in attaining superior yields and quality.

Keywords: Cladodes cuttings, Compost, Epiphytic, Peat mass, Quality

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Introduction

Dragon fruit, generally known as pitaya, comprises diverse species in the genus Hylocereus of the Cactaceae family. It is climbing epiphytic or hemiepiphytic cactus native to the tropical and subtropical regions of America (Arivalagan et al., 2021). Recently, it had substantial attention as economically important fruit crop with widespread cultivation (Sarwar et al., 2024). Dragon fruit has considerable dietary worth and bioactive constituents, containing antioxidants. Several evidence reveals the medicinal efficacy of dragon fruit in controlling type 2 diabetes (Padakatti & Meti, 2020). Dragon fruit is abundant in vitamin C, which is fundamental for improving the immune system (Joshi and Prabhakar, 2020). Additionally, dragon fruit functions as an excellent amount of fibre, boosting gastrointestinal health and inhibiting constipation (Sarwar et al., 2024).

The growth media is essential for the efficient production and development of dragon fruit. The constituents of the media, particularly the mixture of sand and organic substances, could assist as an excellent growth medium for the effective reproduction of high-quality plants (Hayat et al., 2023; Tani et al., 2021). Commonly, dragon fruit is produced by sexual reproduction through seeds and asexual reproduction (grafting and cladode cuttings). The key propagation problem in dragon fruit is stem rot, which occurs from planting uncalloused cladode, upregulation of moisture and poorly drained soil or media. The highest easy, reasonable, and practical technique for raising dragon fruit using cladode cuttings (Kakade et al., 2021). Silt triggers acute and commonly impenetrable rooting and growth issues for dragon fruit cladode cuttings compared to specific potting mix. Silt's very small particle volume makes it compact swiftly and hold extreme water, creating a steadily soggy, oxygen-poor environment. The basal end of an unrooted cladode cutting is more expected to rot than callus, and any growing roots instantly died and harmed by anaerobic microorganisms, subsequent in considerable mortality (Mizrahi & Nerd, 1999). Suitable growth medium has a permeable formation that upholds promptly drainage and most favourable aeration, excellently preserving the cutting against rot by sustaining a wet but unsaturated root zone. This environment advances instant callusing, vigorous root induction, and easy radial growth, assisting the young plant to efficiently attain water and nutrients (Bhardwaj, 2014; Barrett et al., 2016). Hence, a cutting in a suitable potting mix instantly changes a solid root system, promptly proceeds to vegetative extension, and achieves trellis-ready dimensions in a much smaller period than in silt (Barrett et al., 2016).

Indole-3-butyric acid (IBA) is a synthetic auxin, a plant growth regulator that bear a resemblance to the biological auxin indole-3-acetic acid, structured for augmented permanency and effectiveness in accelerating adventitious root enhancement. It is generally accepted as the scale with marketable rooting hormones due to its excellent photostability, steady breakdown, and competent translocation inside plant tissues (Frick & Strader, 2018). IBA is essential for propagation since it promotes cell proliferation and differentiation at the cutting base, expedites the production of root initials, and improves both the pace and consistency of root growth. Its application significantly enhances rooting percentage, root quantity, and root length in challenging-to-root or slow-rooting species such as many woody plants and succulents like dragon fruit while also optimising root system design for improved nutrition and water absorption (Blythe et al., 2007).

Previously dragon fruit variety 'Royal Moroccan Red' treated with soil + cocopeat + vermicompost + 25 mM IBA) significantly enhanced the rooting and growth of cladode cuttings under agro-climatic conditions of North-Eastern Hills Region, Umiam, Meghalaya, India (Rymbai et al., 2025). An earlier study indicated that a rooting medium including IAA (200 ppm) and IBA (300 ppm), combined with soil, sawdust, and sand, showed maximum rooting and plant growth metrics of dragon fruit varieties BAU Dragon fruit-1 and BAU Dragon fruit-2, respectively (Rahad et al., 2016). Similarly, the combination of soil, sand, cocopeat, vermicompost, and IBA (7000 ppm) yielded superior outcomes for the shooting characteristics of dragon fruit cuttings (Minz, 2021). A cost-effective sand + vermicompost (1:1) mixture increases survival rates and fosters balanced vegetative and root development throughout the hardening process in dragon fruits plantlets (Chongloi et al., 2023). Vermiculite growing media had the highest germination rates because to superior aeration and water retention, followed by peat moss, whilst cocopeat and compost produced decreased germination performance in dragon fruit (Sarwar et al., 2024). In addition, combinations of vermicompost and soil demonstrated superiority, producing optimal outcomes for most assessed growth metrics in dragon fruit (Tani et al., 2021). Rough lemon rootstock grown in media [Soil + silt + sand (2: 1: 1) and Rice husk + sand + soil (2:1:1)], exhibited higher plant weight, dry plant weight, fresh root weight, dry root weight, root length, root diameter, leaf area and chlorophyll contents as compared to control treatment (Hayat et al., 2023).

Regarding the significance of growing media and IBA applications, there is a lack of research available on the rooting and growth of dragon fruit cuttings in agro-climatic conditions of Faisalabad, Punjab, Pakistan. Hence, this research aimed to determine suitable growing media combined with IBA and its effects on the rooting and growth performance of dragon fruit cuttings in agro-climatic conditions of Faisalabad.

Materials and Methods

Dragon fruit material and treatments

The current study was conducted in the year 2024-25 at the nursery area of the Horticultural Research Institute (HRI), Ayub Agricultural Research Institute (AARI), Faisalabad (FSD), Punjab, Pakistan (31°24'16" N 73°2'54" E). The experiment was designed using a RCBD and replicated three times. The planting material, consisting of fresh dragon fruit cuttings from one-year-old cladodes of the 'American Beauty' variety, each containing 2-4 nodes, was obtained from the existing dragon fruit block at the fruit orchard of the HRI, AARI, FSD, Punjab, Pakistan. A total of 15 cuttings were collected for each treatment, considering 5 cuttings as a replication unit, which were subjected to IBA treatment and then planted in various growing mediums (Table 1).

Table 1 Description of dragon fruit planting material and treatment combinations comprising different growing media and IBA concentrations

T_0 =	Control (Silt)
T_1 =	Compost + Silt + Leaf manure 1: 2: 2 + IBA 1000 ppm
T_2 =	Compost + Silt + Leaf manure 1: 2: 2 + IBA 1500 ppm
T_3 =	Compost + Silt + Leaf manure 1: 2: 2 + IBA 2000 ppm
T_4 =	Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm
T_5 =	Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1500 ppm
T_6 =	Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 2000 ppm
T_7 =	Silt + Compost 1: 1 + IBA 1000 ppm
T_8 =	Silt + Compost 1: 1 + IBA 1500 ppm
T_9 =	Silt + Compost 1: 1 + IBA 2000 ppm

Sprout initiation (Days), sprouting success rate (%) and survival rate (%)

Sprout initiation was determined from each treatment when buds initiated firstly and expressed as days. The sprouting success rate was calculated by using the following formula: Sprouting success rate = Number of cuttings sprouted / total number of cuttings × 100. Similarly, the survival rate was assessed by dividing the number of plants that survived after 60 days of planting by the total number of cuttings and multiplying by 100. Sprouting success rate and survival rate attributes were presented as percentages.

Plant height (cm), number of cladodes and cladodes length (cm)

The height of the dragon fruit plant was measured from the soil base to the peak with a standard measuring ruler 60 days after planting, and the results were recorded in cm. The total number of cladodes was noted with each replication. The average was recorded and subjected to statistical analysis. The cladode length was calculated from the newly developed cladodes after 60 days of planting by ruler and represented in cm.

Number of roots, root length (cm), root fresh weight (g), root dry weight (g) and root volume (cm^3)

The total number of roots was noted with each replication. The mean was observed and subjected to statistical analysis. The root length was estimated by using ruler and characterized in cm. The root fresh weight of the dragon fruit was assessed utilizing an electronic weight balance (Setra, BL-4100S, USA) and stated as g. The root dry weight of the dragon fruit was assessed after the specimens were thoroughly desiccated at 70°C for a duration of 12 h in an oven, using an electronic weight balance and denoted as g.

Statistical analysis

The current study was executed under RCBD arrangements. The data assessment was conducted via Statistix 8.1 (Tallahassee, Florida, USA), applying the one-way analysis of variance technique. The mean differences among the treatments were assessed using the least significant difference test. The OriginPro 2021 package (Northampton, Massachusetts, USA) was used to assess the correlation across numerous attributes.

Results and Discussion

Sprout initiation (Days), sprouting success rate (%) and survival rate (%)

The phase of sprout initiation is a fundamental immediate attribute of cutting vigour and concentration effectiveness, subsequently it absolutely regulates rooting competence. The results of the current experiment exhibited significant variations among several blends of growth media and IBA concentrations employed to *Selenicereus undatus* cuttings (Table 1). The cuttings cultivated in medium and IBA treatment (Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm) exhibited the shortest duration (30.6 days) to sprout, while the longest duration was seen in cuttings produced under the control treatment (53.3 days), respectively (Table 1). Similarly, statistically highly significant changes were observed in treatments regarding the sprouting success rate and survival rate of cuttings. The treatment (Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm) exhibited a highest sprouting success rate (93.6%) and survival rate (80.4%) of cuttings compared to the control treatment (Table 1). The sprout phase is a crucial parameter in dragon fruit cutting studies, acting as a significant early predictor of cutting vigour and treatment effectiveness. The basic significance is in enabling a swift, non-destructive evaluation of the rate at which a cutting shift from dormancy to active growth, which often corresponds significantly with effective root development and complete development (Minz, 2021). A reduced start time indicates advantageous internal circumstances, such as sufficient glycogen stores in the cutting, as well as appropriate external variables, including hormonal treatment, rooting medium, and temperature regulation. This parameter has obvious economic significance for commercial nurseries, as decreasing the time to sprout may considerably reduce the production cycle and enhance rotation (Tani et al., 2021; Hayat et al., 2023).

The present results of this work relate with the outcomes of Anagha et al. (2025), which reported that the *Selenicereus undatus* grown in media [soil + sand + cocopeat + vermicompost + IBA (7000 ppm)] lead to in sprout initiation in lowest period than control. In this study, the sprouting success rate and survival rate are fundamental, correlated attributes that exhibit the efficacy and process of the propagation procedure. The sprouting success rate is the essential show rate, determining the concentrations usefulness in stimulating meristematic vigor and affecting bud dormancy (Supriya & Singh, 2024). The process is straight influenced by media (well-aerated), moist (unsaturated physical) and hydrological atmosphere that regulates callus establishment without deterioration, whereas the IBA treatments uplifts endogenous auxin levels, enabling cell division and carbohydrate mobilisation to the bud, consequently accelerating and augmenting the regularity of sprout appearance (Rahad et al., 2016). IBA acts a crucial task in this stage by controlling the separation of adventitious roots at the basis of the cutting. Thus, investigative both rates parallel tells the entire process: media-IBA interaction initial assurances quick sprouting and later enables the rooting organization, converting early strength into surviving capability (Anagha et al., 2025; Supriya & Singh, 2024). Similar results with maximum sprouting success rates and survival rates were reported in dragon fruit cuttings grown in several media and treated with IBA treatments (Rahad et al., 2016; Minz, 2021; Sarwar et al., 2024; Anagha et al., 2025).

Plant height (cm), number of cladodes and cladodes length (cm)

The height of the plant, number of cladodes and cladodes length are the key attributes of dragon fruit for assessing plant growth and vigour. The results of the present research indicated that there were highly significant variations among various treatments given to the dragon fruit cuttings (Fig. 1). The dragon fruit cuttings grown in medium with IBA treatment (Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm) demonstrated higher plant height (45.9 cm), total number of cladodes (7.6), and cladode length (16.9 cm), whereas the lowest measurements for plant height (10.7 cm), total number of cladodes (1), and cladode length (5.4 cm), were observed in cuttings from the control treatment (Table 1).

In a dragon fruit cutting trial assessing growing media and IBA treatments, the metrics of plant height (cm), number of cladodes, and cladode length (cm) are essential mid- to long-term growth indicators that collectively evaluate a propagule's successful transition from a dependent cutting to an independently vigorous plant (Rahad et al., 2016). The connection between these measurements and media and IBA treatments is based on source distribution and hormone signalling. Afterwards early sprouting and rooting, a most favourable medium promotes a strong root organisation that efficiently captivates water and minerals, enabling the meristematic movement essential for plant height and the development of new cladodes (Anagha et al., 2025). At the same time, IBA's residual hormonal influence continues in inducing growth: ideal application not only primarily accelerates roots but also upholds stabilized auxin-cytokinin relationships that control apical dominance and bud disclose. This leads to the synchronised development of new cladodes and their ensuing elongation (cladode length) (Zainudin et al., 2018). Previous studies concerning higher height of the plant, number of cladodes and cladodes length were recorded in dragon fruit (Rahad et al., 2016; Minz, 2021; Tani et al., 2021; Chongloi et al., 2023; Sarwar et al., 2024; Anagha et al., 2025) and ornamental plants (grown in indoor and outdoor) (Saleh, 2000; Garcia-Correa et al., 2001) treated with several media and IBA treatments. A treatment that produces exceptional outcomes across all three measures indicates a successful procedure that ensures not just survival but also promotes early canopy growth and hastens the onset of the fruiting period.

Table 1 Influence of growing media combined with IBA treatments on several attributes of dragon fruit

Treatments	Sprout initiation (Days)	Sprouting success rate (%)	Survival rate (%)	Plant height (cm)	Number of cladodes	Cladodes length (cm)
T_0	53.3 a	44.3 g	32.8 g	10.7 i	1.0 f	5.4 h
T_1	38.6 f	80.6 bc	66.8 d	38.0 b	5.3 c	12.9 d
T_2	34.6 h	76.7 c	73.5 b	33.8 d	5.3 c	14.9 b
T_3	35.6 gh	80.4 bc	72.2 c	20.7 f	6.6 b	14.1 c
T_4	30.6 i	93.6 a	80.4 a	45.9 a	7.6 a	16.9 a
T_5	36.6 g	86.6 ab	60.5 e	36.7 c	6.3 b	13.0 d
T_6	50.3 c	60.4 ef	47.2 f	28.5 e	4.3 d	6.6 g
T_7	51.6 b	53.5 fg	46.9 f	19.8 g	3.3 e	5.7 h
T_8	40.6 e	73.5 cd	60.5 e	28.9 e	4.6 cd	11.9 e
T_9	47.3 d	66.6 de	60.8 e	16.9 h	4.3 d	10.6 f
Significance*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD	1.18	1.44	1.08	0.64	0.97	0.30

T_0 = Control (Silt); T_1 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1000 ppm; T_2 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1500 ppm; T_3 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 2000 ppm; T_4 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm; T_5 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1500 ppm; T_6 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 2000 ppm; T_7 = Silt + Compost 1: 1 + IBA 1000 ppm; T_8 = Silt + Compost 1: 1 + IBA 1500 ppm; T_9 = Silt + Compost 1: 1 + IBA 2000 ppm; *The general linear model (GLM) approach of statistics (version 8.1 analytical package) was used to derive *P* values for various panting media and IBA treatments on dragon fruit. The tabular data, displayed as three replications, with varying letters, shows significant differences as defined by the LSD test ($P \leq 0.05$).

Number of roots, root length (cm), root fresh weight (g), root dry weight (g) and root volume (cm3)

The rooting attributes of dragon fruit, including the number of roots, root length, root fresh weight, root dry weight, and root volume, showed highly significant statistical results among the applied treatments (Table 2). The treatment (Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm) exhibited a highest number of roots (17.3), root length (23.9 cm), root fresh weight (2.2 g), root dry weight (1.4 g) and root volume (1.9 cm^3) of cuttings compared to the control treatment (Table 2). The number of roots, root length, root fresh weight, root dry weight, and root volume, are imperative and extremely complex parameters that straight evaluate the usefulness of the rooting development, which eventually impacts cutting growth and enduring strength. Their communal position lies in supporting a broad understanding into the building of the root structure, biomass division, and physiological activities (Hartmann et al., 2010). Growing medium, distinguished by optimum aeration, sufficient moisture maintenance, and physical strength, accelerates callus expansion and undertakes the low-porousness, high-oxygen circumstances vital for the sprouting and development of root primordia. This instantly influences the mass of roots (a marker of induction places) and the size of roots. The growing media organization influences root capacity and biomass enlargement, as an appropriate medium supports unlimited radial growth and water immersion in root masses (Raviv & Lieth, 2008). IBA functions as the basic chemical indication, enhancing endogenous auxin applications near the cutting basis. This regulates cell division, aiding the development of supplementary root primordia and, at best applications, advancing root length (Ludhers and Rimon, 2002). The hormone's usefulness in fluctuating photosynthetic assets to the root zone is ultimately revealed in root dry weight, a vibrant parameter of the plant's stable operational assurance to its root scheme, regardless of water content (Ludhers & Rimon, 2002). Thus, the concentration amalgamation that augments this root system of measurement. Similar effects of higher number of roots, root length, root fresh weight, root dry weight, and root volume were studied in *Selenicereus undatus* (Elobeidy, 2006; Rahad et al., 2016; Sudarjat et al., 2018; Tani et al., 2021; Chongloi et al., 2023).

Correlation evaluation

A Pearson association assessment confirmed considerable positive relationships between the assessed growth and root attributes, exhibiting the consolidative physiological reaction to the propagation methods (Fig. 2). Crucial vegetative attributes, for instance PH and CL, revealed vigorous positive associations with RL and RDW, prominence the straight stimulus of shoot growth on root competence and organizational biomass division. The NC demonstrated a great relationship with the NOR, demonstrating a combined growth of aerial branching and root induction positions, feasibly changed by secure hormonal signalling (Fig. 2). The early formation success, showed by the SSR, displayed a strong positive association with the SR and with all root parameters, upholding that prompt bud break is a reliable attribute of following rooting success and cutting survival (Fig. 2). The substantial interface linked across RFW, RDW and RV indicates that expanding growing roots. The relationship matrix shows that the higher treatment excellently created a positive response loop, in which an enhanced rooting, possible by media properties and IBA concentration, better roots and function, thus improved root expansion and formation success (Fig. 2).

Table 2 Impact of growing media combined with IBA treatments on various traits of dragon fruit

Treatments	Number of roots	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Root volume (cm^3)
T_0	6.3 f	9.6 g	0.76 d	0.2 e	0.8 i
T_1	12.3 c	20.9 c	1.1 bcd	0.8 bc	1.6d
T_2	10.3 e	22.7 b	1.1 bcd	0.8 bc	1.7 b
T_3	12.6 bc	22.5 b	1.1 bcd	0.9 b	1.7 cd
T_4	17.3 a	23.9 a	2.2 a	1.4 a	1.9 a
T_5	13.3 b	21.3 c	1.4 b	0.9 b	1.7 c
T_6	11.3 d	18.8 e	1.1 bcd	0.8 bc	1.2 g
T_7	10.3 e	13.2 f	1.2 bc	0.9 b	1.1 h
T_8	13.3 b	20.0 d	0.9 cd	0.6 cd	1.5 e
T_9	10.3 e	19.4 de	0.8 cd	0.4 de	1.3 f
Significance*	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
LSD	0.93	0.63	0.42	0.23	0.04

T_0 = Control (Silt); T_1 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1000 ppm; T_2 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1500 ppm; T_3 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 2000 ppm; T_4 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm; T_5 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1500 ppm; T_6 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 2000 ppm; T_7 = Silt + Compost 1: 1 + IBA 1000 ppm; T_8 = Silt + Compost 1: 1 + IBA 1500 ppm; T_9 = Silt + Compost 1: 1 + IBA 2000 ppm; *The general linear model (GLM) approach of statistics (version 8.1 analytical package) was used to derive P values for various panting media and IBA treatments on dragon fruit. The tabular data, displayed as three replicates, with varying letters, shows significant differences as defined by the LSD test ($P \leq 0.05$).

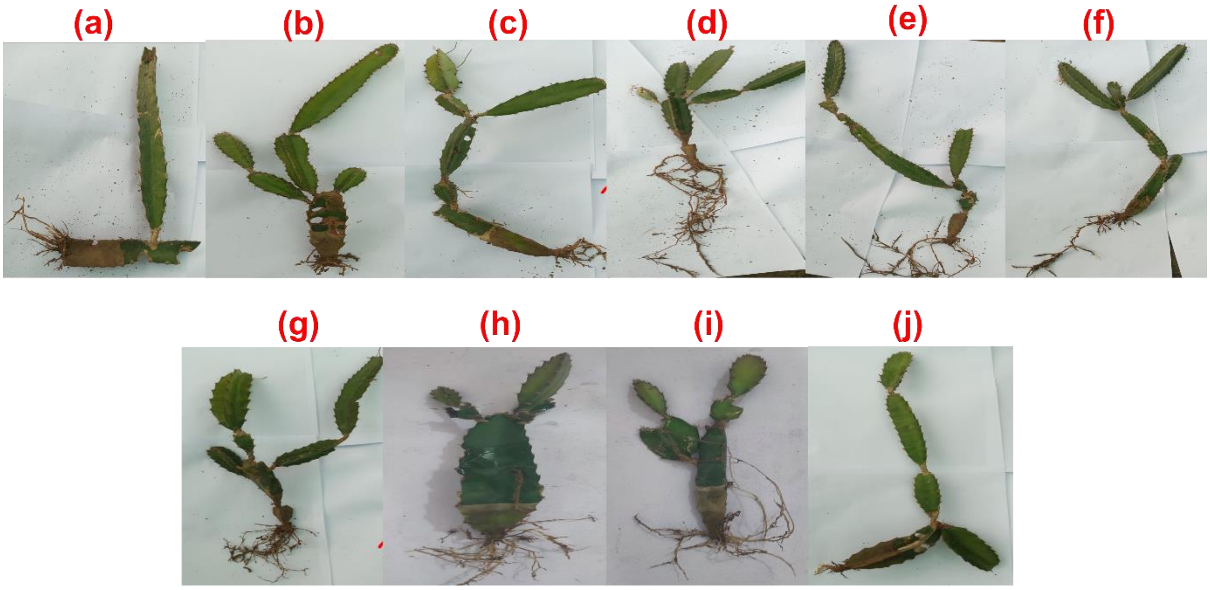

Fig. 1 Phenotypic appearance of *Selenicereus undatus* cuttings after 60 days of planting in various treatments (a) T0 = Control (Silt), (b) T1 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1000 ppm, (c) T2 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 1500 ppm, (d) T3 = Compost + Silt + Leaf manure 1: 2: 2 + IBA 2000 ppm, (e) T4 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm, (f) T5 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1500 ppm, (g) T6 = Good Soil+ Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 2000 ppm, (h) T7 = Silt + Compost 1: 1 + IBA 1000 ppm, (i) T8 = Silt + Compost 1: 1 + IBA 1500 ppm and (j) T9 = Silt + Compost 1: 1 + IBA 2000 ppm

Conclusion

In conclusion, among the used treatments, Good Soil + Silt + Compost + Peat mass 2: 2: 1: 1 + IBA 1000 ppm exhibited higher growth (survival rate, plant height, number of cladodes and cladodes length) and rooting (number of roots, root length, root fresh weight, root dry weight and root volume) characteristics of dragon fruit cv. 'American Beauty' under agro-climatic conditions of Faisalabad, Punjab, Pakistan. The correlation analysis also indicated positive association among growth and root attributes, exhibiting the integrative functional response to the propagation methods. This investigation extends beneficial insights into the performance of many media and IBA concentrations, therefore increasing growth and rooting of dragon fruit cuttings. The study stresses the necessity for future work into other fruit quality and bioactive characteristics of *Selenicereus undatus*.

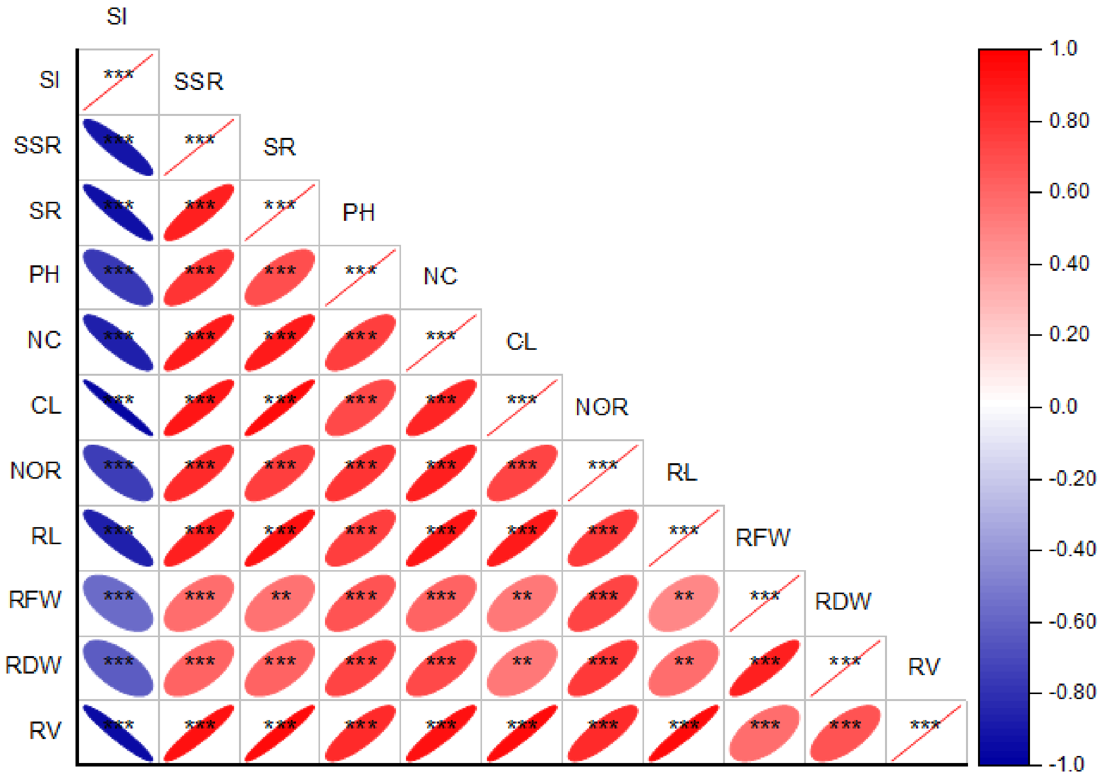

Fig. 2 The correlation of several matrices as affected with growing media and IBA concentrations of dragon fruit. Abbreviations: CL = Cladode length, NC = Number of cladodes, NOR = Number of roots, PH = Plant height, RL = Root length, RDW = Root dry weight, RFW = Root fresh weight, RV = Root volume, SSR = Sprouting success rate, SR = Survival rate, SI = Sprout initiation

Conflict of interest: All authors assert that they have no conflict of interest.

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SDG Relevance: SDG goal 2 (Zero Hunger), goal 3 (Good Health and Wellbeing) and goal 13 (Climate Action)

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