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Synthesis of Bio-Organic Auxin and Comparative Study with Standard Auxin in Plant Growth Promotion

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ABSTRACT: Auxins are a class of plant hormones that play a crucial role in regulating various physiological processes, including cell elongation, root initiation and overall plant growth. This study present a comparative analysis of Bio-organic auxin, extracted from Aloe-vera shoot tips. and standard auxin. The auxins were subjected to Thin layer chromatography (TLC), spectrophotometry and Avena curvature test to evaluate their chemical composition and biological activity. Following these analyses, the extracted auxin was treated with Honey, Turmeric powder, Cinnamon powder to enhance its bioactivity. The formulated Bio organic auxin was subsequently applied to Maize seeds to assess its efficacy in promoting root development. Key growth parameters, including root number, root length and percentage of successful rooting, were systematically recorded and analysed. The result demonstrated that Bio organic auxin exhibited comparable physiochemical properties to IBA, as indicated by TLC and spectrophotometric analysis. Moreover, the application of Bio organic auxin led to a more pronounced enhancement in root development compared to IBA, suggesting its potential as an effective natural alternative to synthetic auxin in plant growth promotion. This study underscores the feasibility of Bio organic auxin as sustainable plant growth regulators, offering a promising avenue for eco-friendly agricultural and horticulture practices.

KEY WORDS: Auxins, Thin layer chromatography, spectrophotometry, Avena curvature test.

I.INTRODUCTION

Phytohormones are natural signaling molecules that regulate plant growth even at very low concentrations. Major types include auxins, gibberellins, cytokinins, abscisic acid, ethylene, jasmonates, salicylates, and brassinosteroids. They control key processes such as stem elongation, apical dominance, root initiation and branching, and responses to light and gravity [1,2]. Rooting agents, especially important for hard-to-root species, help speed up root formation, improve uniformity, and enhance overall rooting success [3].

Auxins are the most researched group of plant hormones, owing to their discovery and widespread usage in plant propagation protocols, as well as their significance in adventitious root production in several species [4,5]. Exogenous hormones are required to compensate for the absence of endogenous hormones in plants that exhibit poor growth, bloom loss, and limited fruit size. The lack of endogenous hormones in plants, which is an issue in the agricultural sector, can be solved by introducing exogenous hormones [6]. Commercial plant propagation frequently employs auxin treatments to boost overall rooting percentages, speed up root initiation, improve the quantity and caliber of roots, and promote rooting uniformity [7,8]. Auxins are the main active ingredient in commercial root-promoting products, which are frequently marketed as "rooting hormones" or used in everyday speech.Natural auxins and other plant hormones, as well as synthetic auxins and other substances with hormonal qualities, are referred to as plant growth regulators (PGRs).

Indole-3-acetic acid (IAA) and indole-3-butyric acid (IBA) are plant hormones belonging to the auxin family.IAA is naturally synthesized in plants, primarily at growing shoot and root apices.While IBA is naturally produced in some plants, it is also widely used as a synthetic auxin. It is known for its ability to stimulate root growth and development, particularly when applied exogenously.

Over the last 70 years, commercial horticulture has mostly used three methods to deliver auxin to stem cuttings. There are three methods for applying the solution: basal quick- dip (concentrated-solution dip), powder (tale or dust), and dilute

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soak (dilute-solution soaking). The most popular application methods are quick-dip and powder, with quick-dip being the preferred approach [9]. The dilute soak method, an old approach, is sometimes used with cuttings of specific species [8]. Among the most popular pre-treatments are hormone applications.

An organic substance called aloe vera has become a viable natural substitute for artificial rooting hormones [10]. Numerous complex substances, including polysaccharides, glycoproteins, phenolic compounds, lignin, salicylic acid, hormones, amino acids, vitamins, and enzymes, are found in aloe vera. These ingredients support its many advantageous qualities, which include immune-boosting, antioxidant, antibacterial, and antifungal activities [11]. Three primary regulatory mechanisms auxin biosynthesis and inactivation, auxin-directed transport, and signal transduction can be used to spatiotemporally control the activity of auxin in a variety of physiological activities [12].

According to reports, vermicompost tea contains macro and micronutrients, growth regulators like gibberellins, indole acetic acid (IAA), and cytokinin, as well as plant available nutrients and organic acids. These substances are said to have a positive impact on plant growth [13]. According to reports, honey contains large levels of sucrose, levulose, dextrose, and sugar [14]. It has been reported, sucrose is a key factor that influences the rooting phenomena in addition to growth regulators and hormones [15]. It is evident that oligosaccharides deposited in plant cell walls have a beneficial impact on root induction and growth [16]. Honey contains a number of vitamins, including C and B1, making it a natural source of these nutrients. Many plants have been shown to initiate roots in cuttings [17]. It has long been known that vitamins help numerous plant species produce root-forming components [18]. Salicylic acid, which is found in aloe vera and cinnamon powder, aids in cutting rooting. It has been demonstrated that aloe vera roots Vitex diversifolia semi hardwood cuttings more effectively than IBA [19]. Turmeric powder has antimicrobial and antifungal properties, useful when applied to cut ends of plant cutting to prevent infection. When it comes to auxin bioassays, the avena curvature test has shown itself to be quite selective for auxin-type growth regulators.

II.RELATED WORK

Previous study has shown that bio-organic auxins produced from natural or microbial sources can promote plant growth with efficacy comparable to standard synthetic auxins [4]. Previous studies have demonstrated that various bio-organic growth regulators and natural biostimulants enhance plant growth responses, providing a sustainable alternative to conventional chemical plant growth promoters[10-13].

III. SIGNIFICANCE OF THE SYSTEM

The synthesis of bio-organic auxin offers an eco-friendly and cost-effective alternative to synthetic auxins, and its comparative evaluation with standard auxin helps validate its efficiency in enhancing plant growth while promoting sustainable and residue-free agricultural practices.The Related works of other scientists are presented in section II, the Methodology is presented in section IV, section V covers the experimental results of the study and discussion, and section VI discusses the future study and conclusion.

IV. METHODOLOGY

Materials

Plant Material

Young and actively growing shoot-tips of Aloe vera (approximately 20–30 g) were collected from a home garden and authenticated by the Department of Botany, Shri Shivaji College of Arts, Commerce and Science, Akola. The shoot-tips were washed with distilled water to remove surface dust particles and then blotted dry with a clean muslin cloth.

Methods

Preparation of Extract

After washing the Aloe vera shoot-tips, the plant tissue was homogenised in 100 mL of ice-cold phosphate buffer (pH 6.8) using a mortar and pestle to break down the tissues and facilitate efficient grinding. Once a fine homogenate was obtained, 100 mL of 80% methanol was added to the mixture to solubilise auxin and other organic compounds. The methanolic mixture was then allowed to stand at 5–6 °C for 12 to 24 hours with continuous stirring. Afterwards, the mixture was filtered through filter paper to remove solid plant debris.

Extraction and Partial Purification

The methanol in the filtrate was evaporated to dryness. The resulting residue was dissolved in a small volume of sodium phosphate buffer (pH 7.0). An equal volume of ethyl acetate was added, and the organic (ethyl acetate) layer, which contained the auxin, was carefully collected. The organic extract was then evaporated until completely dry. Finally, the dried residue was re-dissolved in a small volume of either methanol or water, making it ready for further analysis.

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Experimental Testing Procedures

Analytical Thin Layer Chromatography (TLC):

Analytical thin-layer chromatography was performed on plates coated with silica gel. The plate was cut and both lower and upper borders were marked. One drop of the extracted "bio-organic" auxin and one drop of standard auxin were applied by capillary tube at the lower mark. The plate was then developed using chloroform: acetic acid (9:1) as the mobile phase until the solvent front reached the upper mark. After removal, the plate was sprayed with Salkowski reagent and the result was observed.

UV-Vis Spectrophotometric Analysis:

Stock solutions of both the bio-organic auxin and the standard auxin were prepared using water as the solvent. The UV-Vis spectrophotometer was calibrated using the solvent as blank. Each auxin sample was scanned over a wavelength range up to 530 nm to determine the absorbance maxima (A_{max}). Absorbance readings were recorded at the A_{max}.

Avena Curvature Test:

Oat seedlings were grown in the dark for 5–6 days in order to obtain straight coleoptiles. The coleoptile tips were carefully cut just below the apex, about 2–3 mm from the tip. Small agar blocks (~3 mm in size) were prepared; some blocks were soaked in the bio-organic auxin and some in the standard auxin. After sufficient soaking, the auxin-infused agar blocks were placed on the cut stump of the coleoptiles. The treated seedlings were then placed in a moist environment and incubated undisturbed for several hours. During this period, the seedlings that had received auxin treatment began to bend. Finally, the degree of curvature was measured using a protractor.

Effects of Bio-Organic and Standard Auxins on the Root Growth and Development of Maize Seed:

Three separate pots were prepared and labelled as follows: Group 1 (Bio-organic Auxin-applied Maize Seed), Group 2 (Standard Auxin-applied Maize Seed), and Group 3 (Water-only treated Maize Seed, i.e., Control). To enhance the effectiveness of the bio-organic auxin, a small quantity of turmeric powder, honey and cinnamon powder was added. Healthy maize seeds of uniform size were selected and equally divided among the three groups. Seeds from Group 1 were soaked in the bio-organic auxin solution, seeds from Group 2 in the standard auxin solution, and seeds from Group 3 in water for a few minutes. After soaking, the seeds were planted in soil-filled pots. All pots were maintained under similar environmental conditions with respect to temperature, light, humidity and watering. Seeds were allowed to germinate over a period of 7–10 days. At the end of germination, various growth parameters such as root length and number of roots were observed and recorded. Finally, results were compared among the three groups to evaluate the effectiveness of the bio-organic auxin in promoting maize seed growth compared to the standard auxin and the control.

V. EXPERIMENTAL RESULTS AND DISCUSSION

Analytical Thin Layer Chromatography:

Analytical thin-layer chromatography was performed to determine the Rf value of the auxin present in the sample. After the chromatographic separation and subsequent calculation, it was found that:

The Rf value of the standard auxin (IBA) was 0.79,
calculated using the formula:
Rf = (Distance travelled by solute)/(Distance travelled by solvent)
= 9.5/12
= 0.79

The Rf value of the extracted sample was 0.77,
calculated as:
Rf = (Distance travelled by solute)/(Distance travelled by solvent)
= 9.3/12
= 0.77

The close similarity between the Rf values of the standard IBA and the extracted compound indicated that the sample likely contains auxin. This confirms the presence of auxin-like substances in the test extract, as evidenced by their comparable migration behavior on the TLC plate

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UV-Vis Spectrophotometric Analysis:

The UV-Vis spectrophotometric Analysis was carried out at 530 nm, which is λ max for both bio-organic and standard auxin. Absorbance value of bio-organic auxin 0.101 and absorbance value of standard auxin 0.105 indicates that both auxin show similarly of this wavelength. The similarity in absorbance value shows that the bio-organic auxin and standard auxin have similar chromophoric groups. At 530 nm, it exhibits comparable structural properties related to light absorption. Similarity in chemical structure and absorption property implies that bio-organic auxin might be functionally same as standard auxin. The bio-organic auxin could thus serve as an effective and more sustainable means to commercially available synthetic auxin.

Avena Curvature Test:

The Avena curvature test demonstrated the physiological effect of auxins on coleoptile bending. The bio-organic auxin induced a curvature of 35°, while the standard auxin induced a curvature of 30°. The slight difference in curvature angles suggests that the bio-organic auxin exhibits auxin-like activity comparable to the standard. This indicates its potential effectiveness in promoting cell elongation and plant growth responses.

Effects of Bio-Organic and Standard Auxins on the Root Growth and Development of Maize Seed:

The results of the experiment showed that maize seeds treated with bio-organic auxin exhibited significantly better root growth and development compared to those treated with standard synthetic auxin and plain water. The average root length and number of roots were highest in the group treated with the enhanced bio-organic auxin (supplemented with turmeric powder, honey, and cinnamon powder). In contrast, the control group (water-treated) showed moderate root development, while the standard auxin displayed the least growth. These findings suggest that bio-organic auxin, enriched with natural additives, is a moreeffective and eco-friendly alternative for promoting root growth in maize (monocots/cereals).

V. CONCLUSION AND FUTURE WORK

This study aimed to compare the effectiveness of a Bio-Organic Auxin extracted from alveolar shoot tips and treated with honey, turmeric powder, and cinnamon powder with that of Standard Auxin (Indole-Butyric Acid, IBA) in promoting plant growth. The auxins were analyzed using Thin Layer Chromatography (TLC), Spectrophotometry, and the Avena Curvature Test, all of which confirmed that the Bio-Organic Auxin shared similar physicochemical properties with IBA. When applied to maize seedlings, the Bio-Organic Auxin proved more effective than IBA in enhancing root development, as evidenced by a greater number of roots, increased root length, and a higher percentage of successful rooting. These results suggest that Bio-Organic Auxin may serve as a natural and eco-friendly alternative to synthetic auxins, potentially reducing the agricultural sector dependence on chemical growth regulators and also reduce the cost required for cultivation of crops.

REFERENCES

1. Soedjanaatmadja, U. M. S., Ishmayana, S., Muntari, Z., & Rachman, S. D. (2020). Red algae: Potential source of phytohormones. In A. V. Knyazev (Ed.), *A closer look at hormones*. Nova Science Publishers.
2. Romamenko, K., Kosakovskaya, I., &Romamenko, P. (2015). Phytohormones of microalgae: Biological role and involvement in the regulation of physiological processes. Pt I. Auxins, abscisic acid, ethylene. *International Journal on Algae, 17*(3), 275–289.
3. Owen, W. G., & Lopez, R. (2023). Rooting hormones improve uniformity among vegetative cuttings. MSU Extension. https://www.canr.msu.edu (accessed July 19, 2023)
4. Overvoorde, P., Fukaki, H., & Beeckman, T. (2010). Auxin control of root development. *Cold Spring Harbor Perspectives in Biology, 2*(6), a001537.
5. Wei, K., Wang, L., Cheng, H., Zhang, C., Ma, C., Zhang, L., Gong, W., & Wu, L. (2013). Identification of genes involved in indole-3-butyric acid-induced adventitious root formation in nodal cuttings of *Camellia sinensis* (L.) by suppression subtractive hybridization. *Gene, 514*(2), 91–98.
6. Rachman, S., Mukhtari, Z., &Soedjanaatmadja, U. (2017). Alga Merah (*Gracilariacoronopifolia*) sebagaisumberfitohormonsitokinin yang potensial. *Chimica et Natura Acta, 5*(3), 124. https://doi.org/10.24198/cna.v5.n3.16060
7. Hartmann, H. T., & Kester, D. E. (1959). *Plant propagation: Principles and practices*. Prentice-Hall.
8. Macdonald, B. (1987). *Practical woody plant propagation for nursery growers*. Timber Press.
9. Dirr, M. A., & Heuser, C. W. (1987). *The reference manual of woody plant propagation* (p. 239). Varsity Press.
10. Rajan, R. P., & Singh, G. (2021). A review on the use of organic rooting substances for propagation of horticulture crops. *Plant Archives, 21*(1), 685–692.
11. Silva, C. F. D., Vitorino, L. C., Mendonça, M. A. C., Araújo, W. L., Dourado, M. N., Albuquerque, L. C. D., ... &Souchie, E. L. (2020). Screening of plant growth-promoting endophytic bacteria from the roots of the medicinal plant *Aloe vera*. *South African Journal of Botany, 134*, 3–16.
12. Zhang, Q., Gong, M., Xu, X., Li, H., & Deng, W. (2022). Roles of auxin in the growth, development, and stress tolerance of horticultural plants. *Cells, 11*(17), 2761.
13. White, J., & Doner, L. W. (1980). Honey composition and properties. United States Department of Agriculture, Agricultural Research Service, 82–91.
14. Abo El-Enien, H. E., & Omar, M. A. (2018). Effect of some growth substances on rooting and endogenous hormones of *Casimiroa edulis* L. cuttings. *Zagazig Journal of Agricultural Research, 45*(3), 891–904.

15. Mehrabani, L. V., Kamran, R. V., Hassanpouraghdam, M. B., Kavousi, E., &Aazami, M. A. (2016). Auxin concentration and sampling time affect rooting of *Chrysanthemum morifolium* L. and *Rosmarinus officinalis* L. *Azarian Journal of Agriculture, 3*, 11–16.
16. Turetskaya, R., &Polikarpova, F. (1968). *Plant propagation using plant growth regulators*. Nauka. (In Russian)
17. Chee, P. P. (1995). Stimulation of adventitious rooting of *Taxus* species by thiamine. *Plant Cell Reports, 14*, 753–757.
18. Shidiki, A. A., Ambebe, T. F., & Mendi, A. G. (2019). A comparative evaluation of indole-3-butyric acid and plant extracts as potential rooting enhancers in cuttings of *Vitex diversifolia* and *Cordia milleneii*. *International Journal of Forest, Animal and Fisheries Research, 3*(4).
19. Sari, R. P., Maksum, I. P., Hindersah, R., Ishmayana, S., &Soedjanaatmadja, U. M. S. (2022). Isolation, purification, and characterization of auxin from red algae (*Eucheuma spinosum*) and its application in cayenne pepper (*Capsicum frutescens* L.) plants. *Bulgarian Journal of Agricultural Science, 28*(6), 1088–1098

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