A Review Article on Isolation and Screening of Plant Growth-Promoting

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***Abstract*—The excessive application of chemical fertilizers has prompted significant environmental concerns, necessitating the exploration of sustainable alternatives. This research investigates the potential of plant growth-promoting bacteria (PGPB) derived from spoiled, fermented Cocos nucifera combined with wild turmeric (Curcuma aromatica) to create an environmentally friendly liquid biofertilizer. Various bacterial strains were evaluated for essential plant growth-promoting (PGP) characteristics, such as phosphate solubilization, nitrogen fixation, and ammonia production. Morphological and biochemical analyses confirmed the presence of beneficial microorganisms, with certain strains exhibiting high efficacy in nutrient mobilization. A liquid biofertilizer was developed using the most effective isolates and subjected to field trials on crop plants, measuring its effects on germination, root growth, and overall plant health. The findings indicated a notable enhancement in growth parameters, underscoring the potential of this biofertilizer as a cost-effective and sustainable substitute for synthetic fertilizers. This research not only promotes waste valorization but also advances biofertilizer technology to enhance agricultural productivity.**

***Index Terms*—Phosphate solubilization, Plant growth, Biofertilizer, fermentation.**

I. INTRODUCTION

Agriculture is one of the human activities that contributes most to the increasing amount of chemical pollutants via excessive use of synthetic chemical fertilizers and pesticides, which cause further environmental damage with potential risks to human health. Nitrous oxide (N 2 O) is an example of a chemical pollutant produced by the excessive use of nitrogen fertilizer and is a major source of greenhouse gases causing global warming (Pravin Vejan et al,2016). The presence of waste around us that has not been treated properly yet, environmental issues, and economic factors, provide a potential and at once opportunity regarding them. One way is to utilize waste from the production of porridge, in the form of old coconut water, and side products from a sugar factory, in the form of molasses. Old coconut water is believed, to still contain enough nutrients and microelements that can be used as a medium as well as a source of microorganisms that can be added in the process of making liquid fertilizer (R Darmawan et al 2020). A nutrient-rich substrate for the growth of beneficial microorganisms, especially lactic acid bacteria and yeast, is provided by fermented coconut milk. By reducing organic matter to simpler forms and enhancing plant absorption of nutrients, these microbes support soil health (Bashan et al., 2014). This article reviews the isolation and screening of PGPB from spoiled fermented coconut milk and explores their potential as biofertilizers.

II. MECHANISM OF PLANT GROWTH-PROMOTING BACTERIA

PGPB can promote plant growth by both direct and indirect mechanisms (Glick,1995). The microorganisms (PGPB) provide beneficial compounds, including phytohormones, which defend plants from diseases and pathogens (Vikram Poria et al., 2022). Beneficial rhizobacteria may secrete antibiotics and other compounds antagonistic to plant pathogens. The role of beneficial microorganisms is gaining importance in stress management and the development of climate change-resilient agriculture (Rachel Backer 2018). According to Kloepper and Schroth (1981), PGPR-mediated plant growth promotion occurs through the alteration of the whole microbial community in the rhizosphere niche through the production of various substances. Generally, PGPR promotes plant growth directly by either facilitating resource acquisition (nitrogen, phosphorus, and essential minerals) or modulating plant hormone levels or indirectly by decreasing the inhibitory effects of various pathogens on plant

growth and development in the forms of biocontrol agents (Munees Ahemad 2013).

III. SCREENING FOR PLANT GROWTH-PROMOTING TRAITS

Once isolated, these bacteria undergo screening to identify key PGPB characteristics. Several techniques are used to assess their abilities: Phosphate Solubilization, Nitrogen Fixation, Indole-3-Acetic Acid (IAA) Production, Siderophore production, Ammonia production.

IV. PHOSPHATE SOLUBILIZATION, NITROGEN FIXATION, INDOLE-3-ACETIC ACID (IAA) PRODUCTION, SIDEROPHORE PRODUCTION AND AMMONIA PRODUCTION

1. Phosphate Solubilization:

Even though the amount of phosphorus in the soil is generally quite high, most of the phosphorus is insoluble and therefore not available to support plant growth (Bernard R Glick. Scientifica 2012). The bacterial strains capable of producing organic acids, such as Pseudomonas and Bacillus, play a critical role in breaking down insoluble phosphate compounds Bhattacharyya, P.N (2012). Visual detection and even semiquantitative estimation of the phosphate solubilization ability of microorganisms have been possible using plate screening methods, which show clearing zones around the microbial colonies in media containing insoluble mineral phosphates (Hilda Rodriguez 1999).

2. Fixation:

More than 80% of nitrogen is present in the atmosphere as inert gas which is insoluble to the plants (Zaidi et al.,2017). Nitrogen is converted into ammonia (plant-utilizable forms) by nitrogen-fixing organisms using a complex enzyme system called nitrogenase (Habtamu Mekonnen 2021) Nitrogen free Jensen's agar media was used for the detection of free-living aerobic nitrogen fixers. (Diksha Vishwakarma 2017) .

3. Indole-3-Acetic Acid (IAA) Production:

Auxin is one of the plant hormones that influence the process of forming plant tissues, namely growth, division, cell differentiation, and protein synthesis. IAA is naturally found in plants called endogenous IAA (Gusmiaty et al 2019). It can be produced by microorganisms and is measured by assessing the bacteria's ability to produce this compound when cultured in tryptophan-supplemented media. (Kuswinanti T et al 2015).

4. Siderophore production:

Plant growth-promoting rhizobacteria that produce siderophores are also called siderophilic bacteria. They are major assets to plants by providing the required amount of iron. It has been proven that different kinds of siderophores produced by *Bacillus spp.* It plays an important role in maintaining the ionic balance and inhibiting the growth of pathogenic microbes. (Yihan Wang et al 2022).

5. Ammonia production:

Bacterial isolates were tested for the production of ammonia in peptone water (Farah Ahamed et al 2008). Freshly grown cultures were inoculated in 10 ml peptone water in each tube and incubated for 48–72 h at 28±2 °C. Nessler's reagent (0.5 ml) was added to each tube. The development of brown to yellow color was a positive test for ammonia production (Cappuccino, and Sherman 1992).

V. FIGURE

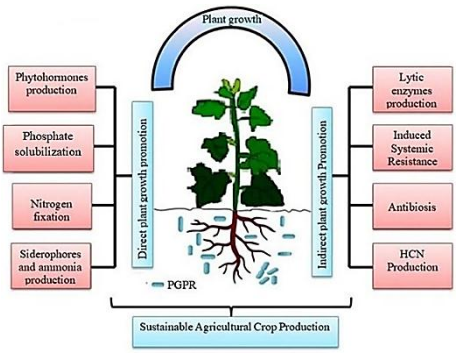

Fig: The roles of plant growth promoting rhizobacteria in sustainable vegetable production in Ethiopia. (Habtamu Mekonnen & Mulugeta Kibret 2021)

VI. APPLICATION AS BIOFERTILIZERS

Extensive studies have suggested that PGPR could have emerged as a promising substitute chemical fertilizer method for agriculture sustainability (Brijesh Singh et al 2022). The use of phosphate-solubilizing bacteria as inoculants simultaneously increases P uptake by the plant and crop yield. (Hilda Rodriguez 1999). They are environmentally friendly as they are natural living organisms. They increase crop yield and production and, in addition, in developing countries, they are less expensive compared to chemical fertilizers. Oluwaseyi Samuel Olanrewaju et al., 2017) . It acts as an eco-friendly alternative to chemical fertilizers, reducing environmental pollution (Adesemoye, A.O et al., 2009). It supports seed germination and root

elongation and it provides plant growth-promoting bacteria (PGPB) that aid in nitrogen fixation and phosphate solubilization and also enhances nutrient uptake efficiency, improving crop yield. Glick, B.R. (2012). Wild turmeric contains curcuminoids, which have antimicrobial properties that suppress soil-borne pathogens. Rajkumar, M., & Freitas, H. (2008).

VII. CONCLUSION

The isolation and screening of PGPB from spoiled fermented coconut milk offer a promising method for developing biofertilizers that can contribute to sustainable agriculture. These bacteria, with their diverse range of growth-promoting traits, hold the potential to improve soil fertility, increase crop yield, and reduce reliance on chemical fertilizers. As global agricultural practices move toward more sustainable solutions, the use of biofertilizers from unconventional sources, such as spoiled fermented coconut milk, could play a pivotal role in shaping the future of crop production.

ACKNOWLEDGMENT

We would like to express our heartfelt gratitude to all those who have contributed to the completion of this review. We extend our sincere thanks to Velumanoharan Arts and Science College for Women for its unwavering support and valuable insights, which have greatly enhanced the quality of this work. Our deepest appreciation goes to our Secretary, Mrs. P. Shakuntala Parthasarathy, our Principal, Dr. A.E.G.C. Rajani and our HoD Ms. R. Mohana Priya for their constant encouragement and for facilitating the successful completion of this research. We also wish to acknowledge the invaluable support and feedback from our colleagues and peers, whose input has been instrumental throughout the process.

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