कृषि अपशिष्ट से संसाधन

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लाभकारी सूक्ष्मजीवों के लिए इमली के बीज आधारित द्रव्यमान बहुगुणन माध्यम का विकास : कृषि अपशिष्ट से संसाधन

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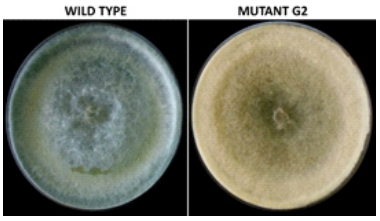

ट्राइकोडर्मा जंगली प्रकार और उत्परिवर्ती नस्ल

सारांश

ट्राइकोडर्मा प्रजाति कई पादप-रोगजनक कवक के विरुद्ध एक जैव कवकनाशक के रूप में कार्य करता है और पौधों में प्रणालीगत प्रतिरोध को प्रेरित करता पाया गया है। ट्राइकोडर्मा प्रजाति के कृषि क्षेत्र में अनुप्रयोगों हेतु द्रव्यमान गुणन की आवश्यकता होती है जिसे ठोस के साथ-साथ तरल अवस्था किण्वन का उपयोग करके प्राप्त किया जा सकता है। इस संबंध में, सस्ते निर्माण के लिए द्रव्यमान गुणन अवस्तर का चयन बहुत महत्वपूर्ण है। इमली के प्रक्रमण से उत्पन्न कृषि अपशिष्ट के प्रभावी उपयोग हेतु इस लाभकारी कवक के विकास के लिए एक आधार सामग्री के रूप में इमली के बीजों का उपयोग किया गया है। उपयोग किए जाने वाला पदार्थ ट्राइकोडर्मा प्रजाति के तेज़ी से विकास के लिए कम लागत वाले द्रव्यमान गुणन माध्यम है। यह पदार्थ ने मौजूदा तरीकों की तुलना में जैव कवकनाशक के बेहतर विकास को समर्थ किया है । इस लेख में प्रौद्योगिकी विकास की सफलता की कहानी को वर्णित किया गया है।

Agro Waste to Resource

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Development of Tamarind Seed Based Mass Multiplication Medium for Beneficial Microbes: Agro Waste to Resource

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Trichoderma wild type and mutant strain

ABSTRACT

Trichoderma sp. act as a biofungicide against many plant-pathogenic fungi and have been found to induce systemic resistance in plants. The field applications of *Trichoderma* sp. require mass multiplication which can be achieved using solid as well as liquid state fermentation. In this regard, the selection of mass multiplication substrate is very important in order to make cheaper formulation. For effective utilization of agro waste generated from tamarind processing, tamarind seeds have been utilized as a base material for growth of this beneficial fungus. The material used is low-cost mass multiplication medium for faster growth of *Trichoderma* sp. This material supported better growth of biofungicide compared to existing methods. Success story of the technology development has been narrated in the article.

KEYWORDS: *Trichoderma, Agro waste, Fermentation, Tamarind Seeds*

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Introduction

Biological suppression of plant pathogenic fungi has been dominated by use of *Trichoderma* sp. all over the world for last 2-3 decades. *Trichoderma* sp. are free-living fungi that are common in soil and root ecosystems. They are highly interactive in root, soil and foliar environments. They produce or release a variety of compounds that induce localized or systemic resistance responses in plants. *Trichoderma* strains have long been recognized as biological agents, for the control of plant disease and for their ability to increase root growth and development, crop productivity, resistance to abiotic stresses and uptake of nutrients. The field application of *Trichoderma* spp. requires mass multiplication which can be done using solid as well as liquid state fermentation. In the industrialized nations, liquid fermentation is extensively used for multiplication of *Trichoderma* sp. for commercial formulation. However, solid state fermentation is preferred in developing countries like India due to low initial investment as well as availability of cheap labour and space. Presently, solid state fermentation technology uses food grains including sorghum and bajra for commercial mass multiplication of *Trichoderma* sp. at an industrial scale. However, the food grains are comparatively expensive, have short storage life and may not be available freely due to climatic stress. Thus, there is an urgent need to develop a formulation based on easily available material and with lower input cost. The availability of food grain is always demanding and they are costly too. Moreover, these grains are also increasing being used for the production of biofuels, thus adding to its cost. Further, the storage life for these food grains is short and grains are useful for solid state fermentation only. On other hand Tamarind seeds are available as a byproduct and fetches negligible price (Rs 10-15 per kg as compared with Rs 50 -75 per kg of sorghum or bajra grains). They can be procured when available and can be stored for longer time. There is another advantage that it can be useful for both solid as well as liquid formulations depending up on the available facility with the user.

Tamarind Seeds

Tamarind, *Tamarindus indica* L., is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed, used as a seasoning or spice, or the fruits and seeds are processed for non-food uses. The species has a wide geographical distribution in the subtropics and semi-arid tropics and is cultivated in numerous regions. Tamarind has been described as one of the common and most important trees of India. Tamarind trees are grown almost in all parts of the country with states like Karnataka, Orissa, Uttar Pradesh, Madhya Pradesh and Tamil Nadu being the major cultivation centers. India is the world's top producer, exporting several thousands of tonnes of seed, seed powder and fruit pulp each year. Tamarind trees are often grown in gardens and along roadsides and are cultivated commercially in plantations. Usually tamarind fruits are used for edible purposes and seeds are thrown away. These seeds could be used for producing starch which is used for sizing in textile industry and as a general adhesive material (Gaurava et al 2024).

Tamarind seed comprises the seed coat or testa (20-30%) and the kernel or endosperm (70-75%). Tamarind seed is the raw material used in the manufacture of tamarind seed kernel powder (TKP), polysaccharide (jellose), adhesive and tannin. TKP usually contains at least 50-60% of the polysaccharides which is a xyloglucan The unit structure of the tamarind xyloglucan exits as xyloglucan heptasaccharide, octasaccharide and nonasaccharide (Nishinari, et al. 2000). The seeds are also used for other purposes and are presently gaining importance as an alternative source of protein, rich in some essential amino acids. Unlike the pulp the seed is a good source of protein and oil. There has been considerable interest amongst chemists, food technologists and nutritionists in the study of the properties of tamarind seeds due to its quality polyose content which have good gelling behaviour (Marathe et al., 2002).

Development of Technology

Mass multiplication methodology for biopesticide Trichoderma sp has been developed and is available for technology transfer to the industries. All the details of the technology are available on BARC Webpage https://barc.gov.in/technologies/tricho/index.html

The technology was also patented with the Indian Patent File No. 1236/MUM/2012[5].

The technology has been transferred to many industries and products based on the technology are available in the market. Details are given in below.

- Pravara Agrobiotech, Sangamner, Dist. Ahmednagar (MS)
- Ajay Biotech, Pune (MS)
- Agriland biotech, Vadodra (GU)
- Borlong biotechnologies Pvt ltd, Lucknow (UP)
- Ponalab, Bangalore (KA)
- Organica, Govandi, Mumbai
- Panzen Organics Narayangaon, Pune
- Plant Health Solutions, Solapur

Different products based on the technology are available in the market. The products include the following as described in Fig. 1.

Fig.1: Commercial products based on tamarind seed-based formulation of Trichoderma virens, Mass multiplication medium technology has demonstrated the application of low cost material as a growth medium for the agriculturally important microorganism.

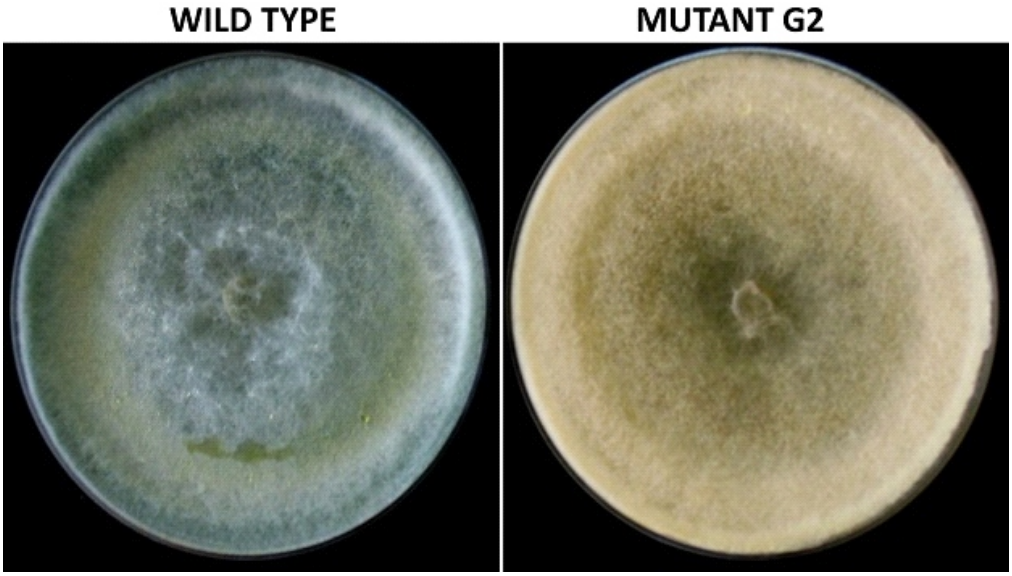

Fig.2: Trichoderma wild type and mutant strain.

Mutagenesis of *Trichoderma Virens*

In order to develop an effective strain for improved disease control under field condition, induced mutagenesis by gamma radiation was practiced at BARC. Sporulated culture (grown in potato dextrose agar slants) of wild type strain of *T. virens* was irradiated with 1250 Gy of gamma-rays (GC5000, BRIT, India). The spores were harvested in sterile distilled water and dilution-plated on PDA amended with rose Bengal (100 mg/L) to restrict colony growth. Morphologically different colonies were transferred to fresh PDA plates. One colony having brown colour conidia and secreting dark pigments in the medium was purified by repeated single-spore isolation and found to be mutant strain (Fig. 2).

The mutant strain was further characterized for the antifungal assay, antibiosis, secondary metabolite production, invitro disease inhibition, *in vivo* inhibition of disease etc. All these studies showed superiority of mutant strain over wild type strain (Mukherjee et al, 2019).

Trichoderma mutant strain showed profuse growth on tamarind seeds (Fig. 3) and was further used for making formulation for field application.

The *Trichoderma virens* mutant strain technology has been combined with mass multiplication medium technology and offered as technology package to industries This technology has transferred to five different companies. Of which, M/s Embio, Mahad has launched a commercial product in the market (Fig. 4).

Further the tamarind seed based medium was also used for BARC-Biostimulant, an actinomycetes strain *Streptomyces rochei* that provide plant growth promotion along with modulation of resistance to damping-off disease.

Thus, the tamarind seeds generated as a low-cost byproduct of tamarind processing has been successfully utilized as a growth medium for mass multiplication of different bio agents.

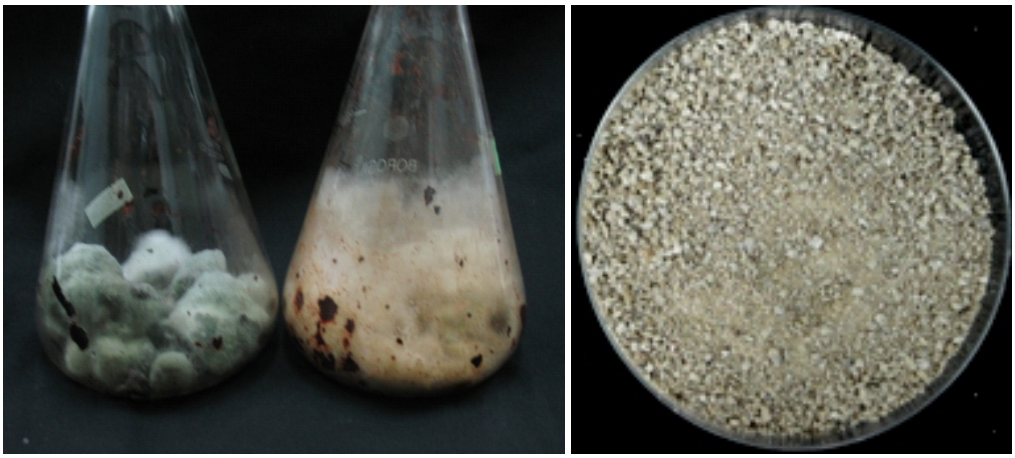

Fig.3: Trichoderma wild type and mutant strain.

Fig.4: Viren: Commercial product of tamarind seed-based formulation of mutant Trichoderma virens.

Conclusion

Mass multiplication of different biocontrol microbes plays significant role in terms stability of the formulation as well its efficacy under field conditions. Trichoderma species has shown promising results when grown on complex substrate rather than simple medium. Tamarind seed-based mass multiplication medium has demonstrated positive results on growth as well as improvement in disease control ability by the microbes.

Thus, tamarind seed-based media enhanced the mass multiplication, gave formulation stability, and improved performance under field conditions of Trichoderma biocontrol agents, demonstrating a sustainable "waste to wealth" technology for farmers.

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