BIOPROSPECTING OF ENDOPHYTES IN AGRICULTURE

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Soil microbes and plants are the most important component of soil ecosystem. These two are in constant interaction with each other and have co-existed under similar climatic conditions. In due course of interaction some microbes colonized and established inside the plant parts and remained as endophyte. All microorganisms that inhabit, at least for some period of their life cycle in the interior of a plant healthy tissues without causing any apparent symptom of disease are called endophytic microbes. Endophytic microbes may stimulate host plant growth through several mechanisms like biological control, induced systemic resistance to plant pathogens, nitrogen fixation, phytohormone production and enhancement of nutrient and water uptake. In general, the value of a particular plant species is determined based on the biochemical compound produced by the plant, but in many cases endophyte present in those plants works better than the biochemical compoundsin producing the intended result through the natural products made from the plant. For example, the snakevine (*Kennedia nigriscans*) crushed and heated in an aqueous brew by local Aborigines in southwest Arnhemland to treat cuts, wounds, and infections. It was found that, the healing effect of plant was because of presence of a novel endophyte, Streptomyces sp. that produces wide-spectrum novel peptide antibiotics called munumbicins which prevent sepsis. Similarly, *Achnatherum robustum*, commonly known as sleepy grass, (synonyms *Stipa robusta*, also *Stipa vaseyi* subsp. robusta) is a perennial plant in the Poaceae or grass family inducing sedative effect on the animals grazing on it. It was learnt that the sleepy grass plants harbors a fungal species (of the genus *Neotyphodium*) producing ergoline compounds, such as lysergic acid amide (common name, ergine). These compounds appear to be responsible for the sedative effects on mammals when they ingest the infected grass.

WHY TO MAP ENDOPHYTES?

Application of plant growth promoting bacteria can be a potential option for enhancing growth and yield of plant in sustainable manner. Very often; response of applied inoculums to the soil for plant growth promotion gets diluted compared to the efficiency observed in lab study primarily because the interaction between microbes and plants in soil environments are complex and difficult to manage. However, the effect had been conspicuous when the plant possessed endophytic colonizers like rhizobia, mycorrhizae and actinorrhizae. Further, detailed investigations of the internal microbiota of plants will uncover novel taxa and reveal new distributions of known species. Because endophytic infections are inconspicuous, the species diversity of the internal mycobiota is relatively high (both within and among individual host species), and a relatively small proportion of potential hosts have been examined, endophytes may represent a substantial number of undiscovered microbes.

RATIONALE FOR PLANT SELECTION

While choosing the plant for studying its internal biota, it is always wise to select

- Plants from unique environmental settings or with an unusual biology, and adopts novel strategies for survival.
- Plants with ethnobotanical history that are related to the specific uses or applications of interest.
- Plants that are endemic, that have an unusual longevity, or that have occupied a certain ancient land mass are also more likely to lodge endophytes with active natural products than other plants.
- Plants growing in areas of great biodiversity also have the prospect of harbouring endophytes with great biodiversity.

BIOPROSPECTING OF ENDOPHYTES

Endophytic bacteria are able to lessen or prevent the deleterious effects of certain pathogenic organisms. Endophytic strains of *Ralstonia solanacearum and Bacillus* have been reported to reduce the severity of fusarium wilt disease in tomato and banana. Endophytic bacteria viz *Bacillus* sp. and as *Enterobacter* sp, *Rahnella, Rhodanobacter, Pseudomonas, Stenotrophomonas, Xanthomonas and Phyllobacterium* isolated from different plant parts of various crop species have been foung to improve the crop growth by increasing germination

percent, nutrient fixation/solubilization, production of phytohormones like IAA and siderophores.

Study at ICAR-IISS on Linseed root endophyte resulted in isolation of 12 bacterial isolate many of which could grow on nitrogen free media, solubilize inorganic phosphate and produces indole acetic acid in media (Plate1).In another study, 4 endophytic bacterial isolates were obtained from root of corn plant and out of the four isolates, MER 4 was able to solubilise tri calcium phosphate in media (phosphate solubilization index 2.86) and releases potassium from gluconite to the extent of 6.0 µg/ml broth containing 10^7 viable cells/ml. The isolate also recorded very good IAA production ability ($p<0.05$; 12.7 µg/ml broth). Microscopic and biochemical characterization revealed the isolate being Gram negative rod, catalase negative, oxidase positive and motile. The isolate may be potential bioinoculum for improving nutrient use efficiency (Figure 2, 3, 4). Co-inoculation MER4 with a diazotrophic isolate resulted in better growth of wheat compared to unfertilized, uninoculated control (Figure 4).

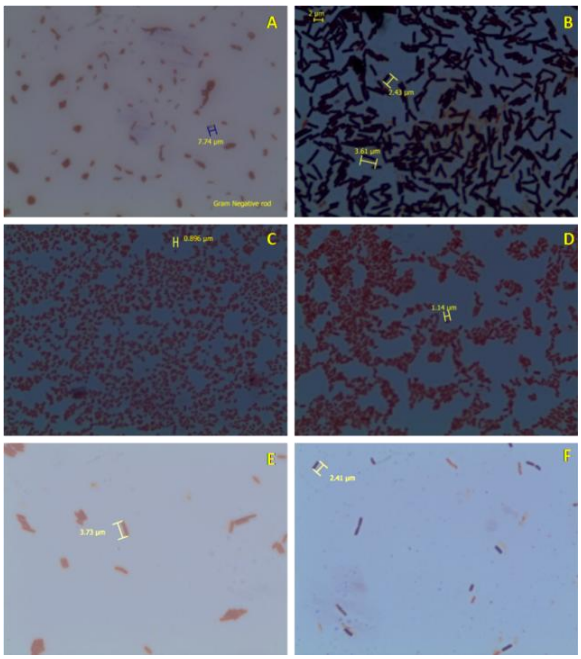

Figure 1. Endoplytic isolate from linseed root (A:LS1; B; LS6; C:LS8; D: LS11; E: LS12; F: LS13)

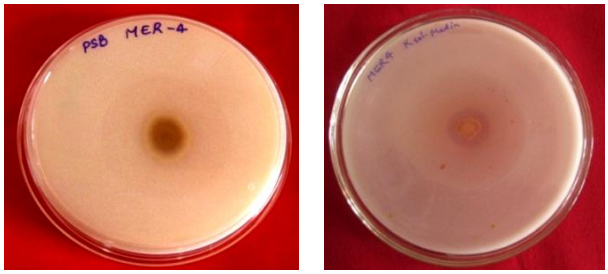

Figure2.

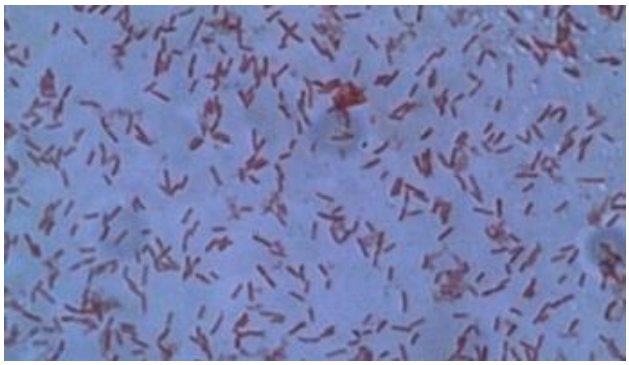

Figure3.

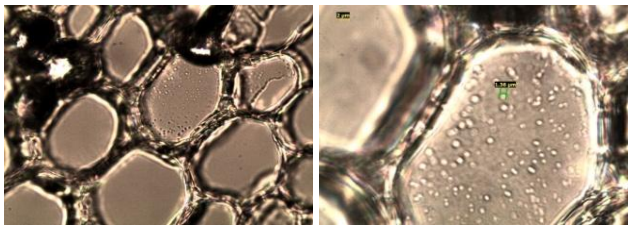

Figure 4. Micrograph (40Xand 100X) of endophytic colonization of bacteria in wheat root

CONCLUSION

Although the plant-endophyte interaction has not been fully understood yet, it has been reported that many isolates provide beneficial effects to their hosts like preventing disease development by synthesizing novel compounds and antifungal metabolites. Several bacterial endophytes have been shown to support plant growth and increase nutrient uptake by providing phytohormones, enzymes, antimicrobial substances like antibiotics and siderophores. Some endophytes offer increased resistance to pathogens thus ideal candidates for biological control. Other beneficial effects of endophytes to plants include nitrogen fixation, increased drought resistance, thermal protection, survival under osmotic stress and more recently, their potential for enhanced degradation of several pollutants has also been investigated. Investigations of biodiversity of endophyte strains for novel metabolites may identify new drugs for the treatment of human, plant and animal diseases, besides revealing new habitat for existence and distribution of microorganisms. Majority of the crop species examined are reported to be colonized by microscopic endophytic flora inherently. Their role, mechanism of colonization and significance are yet to be ascertained.

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