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I. Academic/Professional qualifications

- PhD in Botany**,** Mahatma Gandhi University, Kerala – *2018*
- National Eligibility Test (NET)**,** Council of Scientific & Industrial Research (CSIR) – *2009*
- Post MSc Diploma in Plant Genetic Engineering**,** Madurai Kamaraj University, Tamil Nadu – *2011*
- MSc in Botany (84.32%), Mahatma Gandhi University, Kerala – *2009*
- BSc in Botany (83.10%), Mahatma Gandhi University, Kerala – *2007*
- Higher Secondary (Plus Two) – 63%, Govt. Higher Secondary School, Kottayam, Kerala – *2004*
- SSLC (10th Standard) – 71.16%, Govt. Higher Secondary School, Kottayam, Kerala – *2002*

II. Teaching Experience: 8 Years 1 Month

III. Publications

a) Research articles in Journals (Peer reviewed/UGC-CARE Listed): **10**

b) Book (Edited) Published: **1**

c) In conference Proceedings: **03**

d) Book chapters: **02**

e) Presentation in Seminar/Conference: **08**

f) Invited Lectures/Resource person: **08**

g) No. of seminars/conferences organized: **04**

h) No. of seminars/conferences/workshops/FDP attended: **51**

IV. Book Publication

Proceedings of the First International Seminar on Biotechnology and Life Sciences (ISBTL-2024), organized on 8th and 9th November 2024. *ISBN: 978-81-959833-3-9*. Edited by Dr. Santosh Kumar Singh, Dr. Ramya Raghavan, Dr. **Nidheesh KS**, Dr. Neethu Asokan, Dr. Rajeshwari Ullagaddi, Dr. Kritish De, and Mr. Vinay Hooli.

V. Research Guidance

a) PhD Guidance: 3 (1 Awarded, 3 Undergoing)

b) Number of M.Sc Thesis submitted under guidance: 17

VI. Details of Experience and Key Responsibilities held

Position and Institution	Key Responsibilities	Duration
Assistant Professor, Department of Lifesciences, Sri Sathya Sai University for Human Excellence, Kalaburagi, Karnataka-585313	• Member, Department Advisory Board • Conduct classes and providing guidance and supervision to UG and PG students	18.12.2023-to date
Assistant Professor & Head, Department of Botany, St Joseph University, Chumoukedima, Nagaland	• ***Head of the department*** (July 2019 to 15 October 2022) • *Chairman*, Board of Studies (Botany) • Implemented *NEP* for UG and PG Botany • Member, Board of Studies in Biotechnology • *Coordinator*, Indian Society for Technical Education (ISTE) • Coordinator of *MoU* between Department of Botany, St Joseph University and ICAR-NRC on Mithun • Coordinator of *MoU* between Department of Botany, St Joseph University and LMLC • Executive *Editor*, International Journal of Innovative Lifesciences • Member, *Editorial Board*, SJU Newsletter • Member, *Training and Placement Cell* • *Co-coordinator*, Nature club • *Co-convener* –Student disciplinary committee	02.07.2018-15.10.2022 (4 Y, 3 M)
Adjunct Faculty, National Institute of Plant Science Technology (NIPST), Mahatma Gandhi University, Kerala	• Conduct classes and providing guidance and supervision to PG students of Botany and Plant science technology	11/06/2014-10/06/2015 and 20.10.2022-27.11.2023 (2 Y, 1 M)

VII. Peer Reviewing

1. Journal of Environmental Toxicology and Chemistry (Published by Wiley, Online ISSN:1552-8618)
2. Journal of Agroecology and Sustainable Food Systems (Published by Taylor & Francis, Online ISSN: 2168-3573)
3. Algerian Journal of Bioscences (Published by Department of biology faculty of sciences Faculty of Natural Sciences and Life University of Echahid Hamma Lakhdar, Algeria, eISSN: 2716-9375)

4. American Journal of Plant Sciences Published by Scientific Research Publishing, USA, ISSN Print: 2158-2742, ISSN Online: 2158-2750

VIII. Awards and achievements

i. ***Best Paper Award****:* Nidheesh K S and Kohlise Sangtam 2020, AM Fungal Spore Diversity in the Rhizosphere Soils of Bamboo (*Dendrocalamus hamiltonii* Nees & Arn.ex Munro) Growing in Nagaland, Northeastern India', International Conference on Sustainable Utilization of Tropical Plant Biomass - Opportunities for innovation and Entrepreneurship in Kerala

ii. ***CSIR-NET***- December 2009 AIR 183

iii. ***Academic performance and merit cum means award*** by Department of Botany, St. Berchmans College, Kottayam, Kerala, India, 2008

iv. ***Best outgoing student*** award by Alumni association, Department of Botany, Government College, Kottayam, Kerala, India, 2007

IX. Research Experience

1. PhD Research Scholar (2014-2018) at School of Biosciences, Mahatma Gandhi University, Kerala, India
2. Project fellow (2012-2015), UGC-Major Research Project, at School of Biosciences, Mahatma Gandhi University, Kerala, India. Experience in managing research lab, chemicals and instruments

X. Memberships in academic bodies

1. Annual Member, American Society for Microbiology
2. Individual member, Global Forum for Sustainable Rural Development (GFSRD)
3. Life Member, Scientific and Technical Research Association (STRA)
4. Member, International Society for Environmental Information Sciences (ISEIS)

XI. Workshop/Webinars Conducted

1. Introduction to Intellectual Property Rights at MES college, Erumeli, Kerala on 07 January 2020
2. Reference and citation management using Mendeley software for Department of Botany, St Joseph University, Nagaland on 17 October 2020
3. Reference and citation management using Mendeley software for Department of Botany, Immanuel College, Dimapur, Nagaland on 30 November 2020
4. Biofertilizers for sustainable Agriculture and Environment, for KVM college of Science and Technology (recognized by CUSAT) on 19 October 2020

XII. Publication in popular science magazines/ Newspapers

1. Nidheesh K S and J G Ray. 2017. Biofertilizers as the major means of sustainable agriculture: Mycorrhiza. Science Way Magazine (February, 2017), Publication of Science Education Trust, Archdiocese of Changanacherry, Kerala, India, pp: 4-8.
2. Heavy metal contamination in South Indian banana fields. 2018, The Hindu, published on 02.19.2018, pp-14
3. Heavy metal contamination-Salem and Elur districts of Tamil Nadu. 2018. Dinamalar. Published on 17.09.2018 p-1

Experimental Agriculture (2019), 1–10
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CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Native arbuscular mycorrhizal fungal isolates (*Funneliformis mosseae and Glomus microcarpum*) improve plant height and nutritional status of banana plants

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(Received 08 January 2018; revised 27 October 2018; accepted 23 January 2019)

Abstract

An experiment was carried out to assess the benefits of native arbuscular mycorrhizal fungi (AMF) for banana plants cv. 'Nendran'. The AMF species applied were *Funneliformis mosseae* and *Glomus microcarpum*, which were identified in a previous survey as the most common root associates of *Musa* spp. in traditional monoculture banana fields. Spores of both the AMF species isolated from the natural banana fields were mono-cultured and used in the experiment, individually and in combination, at two inoculum spore levels (2500 or 5000 spores). We evaluated the root colonising potential of AMFs and their effects on plant height, chlorophyll content and leaf N, P and K concentrations at regular intervals up to 90 days after inoculation. All the inoculated plants showed more than 80% root colonisation. Increase in chlorophyll content in the leaves was found significant in all treatments, with the exception of the combination of 5000 spores of *F. mosseae and* 5000 spores of *G. microcarpum* each. Increases in leaf N, P and K were found in all the inoculated plants as compared to control (sterile soil without any AMF). While a significant reduction in soil available nitrogen and soil pH was observed in all treatments with inoculation, the soil available phosphorus and soil total organic carbon were increased by inoculation. Overall data revealed positive effects of AMF species in banana, especially during its early growth. As AMF species were isolated from fields differing in relation to banana variety and soil type and have positive effects in banana nutrition, an integrated soil fertility management using AMF appears promising.

Keywords: *Funneliformis mosseae*; *Glomus microcarpum*; Native AM fungi; Nendran; South Indian Banana

Introduction

Banana, one of the most consumed fruits worldwide, is a common crop in tropics, where it is cultivated in monoculture traditional farms and requires high amount of nutrients as well as chemical control of insects and diseases. However, environment contamination by overusing chemical fertilisers and pesticides is common in banana production systems all over the world (Mahecha-Vásquez *et al.*, 2017). Excessive chemical application in fields due to the intensive crop production strategies is usual in India. In order to overcome the widespread environment pollution quite common from such 'chemicalised' green revolution fields, an alternative farming strategy with minimum environment impact is desirable.

Arbuscular mycorrhizal fungi (AMF) are well-known root symbionts capable of increasing the effective absorbing area of plant roots. AMF are also capable of bringing about biochemical changes in nutrient-deficient soils and to enhance the availability of nutrients to associated plants (Balakrishnan and Subramanian, 2016). Beneficial effects of different species of AMF towards

Symbiosis
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Ecology of Endomycorrhizal Association in Musa spp. of South India

K. S. Nidheesh[1,2] · N. Valsalakumar[2] · V. P. Potty[2,3] · J. G. Ray[1,2]

Received: 22 December 2016 / Accepted: 6 September 2017

Abstract This is the first report of a comprehensive ecological investigation of AMF symbiosis in banana over a very broad zone of its commercial cultivation, South India. The AMF characteristics in relation to specific banana varieties, soils and seasons are carried out. This baseline data has global use for mycorrhizal applications in the crop. Spore density and percentage root colonization in relation to soil fertility parameters, seasons and soil series, along with other ecological parameters are assessed as per standard methods. Altogether 14 different AMF species of 13 different banana varieties, in terms of spore density and percentage colonization from 47 different soil series of South India are discovered. Among the 14 AMF species observed, *Dentiscutata nigra* is a new report in banana. Shannon's diversity index and Simpson's index over seasons are measured. Evenness in AM fungal population in banana fields in the monsoon was higher than that of summer. Presence of over 30% AMF root colonization in majority of banana varieties revealed its significance in the crop.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s13199-017-0508-1) contains supplementary material, which is available to authorized users.

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Keywords AM-fungi · Root-colonization · Seasonal-variation · South-Indian banana · Spore-density · Sustainable-agriculture

1 Introduction

Arbuscular Mycorrhizal Fungi (AMF) with its roles in Phosphorus (P) or other mineral nutrition and ecosystem services including carbon sequestration (Smith and Smith 2011) is inevitable to sustainable agriculture. Since, 'chemicalized farming practices' in the 'green revolution' agricultural belts remains the major cause of ecosystem failure, widespread eutrophication and ill-health of humans throughout the world (Padmavathy and Poyyamoli 2011), alternative biological soil fertility management becomes all the more important. Judicious use of AMF has the potential to reduce excessive applications of chemical fertilizers (Ray and Valsalakumar 2010). Therefore, investigations of AMF in diverse crops and soil environments become highly significant. In this context ecology of AMF in Musa sp. over the entire South India is carried out.

Accessibility to mineral nutrients in required quantities at the exact time of need of a crop is significant to improve yield. In banana, a heavy feeder crop (Moreira and Fageria 2009), provision of nutrients at optimum level during various stages of its growth is a real challenge. Plant growth promoting and beneficial activities of Arbuscular Mycorrhiza (AM) are well known (Usuga et al. 2008a; Usuga et al. 2008b). The potentials of AM to provide specific nutrients in adequate amounts, in diverse crops, under field and experimental conditions (Hijri 2015; Valsalakumar et al. 2007) are thoroughly explored themes. Knowledge of indigenous AM fungi associated with a crop is essential to organize its proper nutritional management practice (Mehta and Bharat 2013; Sieverding 1991; Solaiman

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Environmental Science and Pollution Research
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RESEARCH ARTICLE

Heavy metal contamination in ‘‘chemicalized’ green revolution banana fields in southern India

Nidheesh Kammadavil Sahodaran[1] · Joseph George Ray[1]

Received: 13 March 2018 / Accepted: 5 July 2018

Abstract

The present report is a general assessment of the level of nutrient and toxic heavy metals as an impact of “chemicalized” cultivation practices for decades in banana fields in the three south Indian states, Kerala, Karnataka, and Tamilnadu. The major objective was to critically analyze the status of metallic content in green revolution fields, where chemical fertilizers or plant protective chemicals remain the major source of heavy metal contaminants. Since soil series being a soil taxonomic category that includes slightly variant soils of similar origin and common parent materials, the 286 field samples of the broad south Indian region were further grouped into composite samples representing 47 different soil series for limiting the sample analysis. The quantitative assessment of ten metals done in these soils using the Atomic Absorption Spectrophotometer included Ca, Mg, Mn, Zn, Fe, Cu, Pb, Ni, Cr, and Co. The amount of Cu observed in many fields was higher than all the previous reports of the same in the “chemicalized” fields. Similarly, the amount of Co observed in 25 fields was above its threshold levels expected for normal soils. The amount of Pb observed in all the soils appeared quite normal. The amount of Ni observed in 14 soil series was higher than its threshold levels for normal soils, except in 4 soil series, where its amount exceeded the upper limit of contamination. Cr was detected in all the samples, but found higher than its threshold level in 31 soil series. Significant positive correlations were observed between the amounts of different metals in the study. PCA results indicated that variables were correlated to four principal components, and 74.36% of the total variance was justified.

Keywords Banana · Heavy metal contamination · Southern Indian soils · Soil series · Cultivated soils · Green revolution fields

Introduction

India is the largest producer of bananas in the world, accounting for 27.8% of total banana production, which equals 33.4% of the total fruit production in India (National Horticulture Board 2016). The states of Kerala, Tamilnadu, and Karnataka are the three most important banana-producing regions in India. Since the inception of the green revolution in the 1960s (Padmavathy and Poyyamoli 2011), agriculture in India has increasingly relied on the excessive use of chemical fertilizers and pesticides. Toxic heavy metal contaminants in inorganic chemical fertilizers (Bora et al. 2015) or pesticides may accumulate in soils, which are either absorbed into the crop or leach out into surrounding water (Singh et al. 2001). Heavy metal contaminants in field soils may possibly enter the human food chain, leading to biomagnification (Lin et al. 2010; Malan et al. 2015). Chronic environmental contamination through heavy metals occurs when metals in soils form complexes with organic matter (Efremova and Izosimova 2000) and are gradually released into ground or surface waters or cause a decrease in soil pH (Malan et al. 2015). Decrease in soil pH accelerates more dissolution and leaching out of metals into surface waters, aggravating the overall contamination issue. A large share of nutrients and metal contaminants in banana fields has the potential to cause widespread eutrophication and metal toxicities in banana-cultivating regions. The presence of heavy metals in certain banana field soils in China (Lin et al. 2010) has already been observed. In general, banana is a heavy feeder crop, but comprehensive investigation on the metal contamination in green revolution fields where banana is grown has not been conducted in India to date. To the best of our knowledge, this report is the first to describe heavy metal contamination in commercially cultivated banana fields in India.

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Taylor & Francis Group

Assessment of soil fertility characteristics of chemical-fertilized banana fields of south India

J. G. Ray and K. S. Nidheesh

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ABSTRACT

Soil fertility status of continuously cultivated, chemical-fertilized banana fields of the south Indian states, Kerala, Karnataka, and Tamilnadu, in relation to seasons and varieties is assessed. The major goals were to identify soil types in terms of soil fertility characteristics and specific banana varieties of the region. The focus was to assess specific soil parameters favoring specific varieties, if any, towards global applications. Altogether 286 soil samples collected at random from 143 fields of 13 cultivated varieties, representing 47 different soil series in two seasons, are analyzed and compared. Soil pH and nutrient parameters of different banana variety cultivated fields remained significantly different. Total phosphorus and potassium content of these soils remained normal, but soil nitrogen content was low. The investigation remains a good model for the inventory of specific soil types, soil nutritional characteristics, and ecological amplitude of specific crop of high varietal diversity over a broad area.

ARTICLE HISTORY
Received 17 October 2017
Accepted 11 December 2018

KEYWORDS
Banana; Indian soils; monoculture; plant nutrition; soil fertility; soil fertility management

Introduction

Banana is one of the staple fruit or food crops of Asian, African, and American tropics (Mustaffa and Kumar 2012). The crop is widely cultivated in Australia (Pattison et al. 2008) and French West Indies (Levillain et al. 2012) also. India is the largest producer of banana in the world with 27.8% of total banana production, which equals 33.4% of total fruit production in the country (National Horticulture Board 2016). It is also one of the centers of origin of banana. Southern and northeastern states, as well as Andaman and Nicobar Islands, are the major zones of banana cultivation in India. Over 1,000 varieties of banana are known in India since very ancient times. The states of Kerala, Tamilnadu, and Karnataka are three important banana-producing regions of India, and here, the crop is cultivated over an area of 250 thousand hectares (National Horticulture Board 2016). Since the introduction of 'green revolution' farming in India in the 1960s, commercial production of banana is practiced as a chemical-fertilized (chemicalized) monoculture crop over a broad area in south India. However, no general assessment of the fertility status of chemicalized fields of any specific regions or specific crop in India is yet made for global comparisons. Therefore, an inventory of the range in soil fertility parameters of banana cultivated soils of south India is highly significant for better comparison of similar chemicalized banana cultivated soils of the global tropics.

Nutrient management in soils for banana is a well-explored theme (Mustaffa and Kumar 2012). It is well known that banana grows under a wide range of agro-climatic conditions (Indira and Nair 2008), and the nutrient requirement of this 'heavy feeder crop' is very high (Mustaffa and Kumar 2012). However, general information on soil fertility parameters of a crop of high varietal diversity over a broad area is highly beneficial to organize sustainable cultivation

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Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/lcss.

Probiotics and Antimicrobial Proteins
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Beneficial Changes in *Capsicum frutescens* Due to Priming by Plant Probiotic *Burkholderia* spp.

Rohini Sabu[1] · R. Aswani[1] · K. S. Nidheesh[1] · J.G. Ray[1] · A. Remakanthan[2] · E. K. Radhakrishnan[1]

Abstract
Plant probiotic mechanisms of endophytic microorganisms are highly remarkable as it play key role in growth and health of plants. Even though *Burkholderia* spp. have been studied for their role in plant growth and disease management, report on their field performance is very limited. Hence, the objective of the study was to investigate the plant probiotic performance of selected *Burkholderia* spp. on *Capsicum frutescens*. The results of the study showed bacterial influence on growth of *C. frutescens* with remarkable induction of early flowering and fruiting. Most interestingly, the plants treated with *Burkholderia* strains, ZoB74 and ZoB82 were found to have limited infestation with *Bemisia tabaci*. However, the control plants and those treated with *Burkholderia* ZoB86 were observed to have stunted growth with crumpled and curled leaves with no flowers or fruits. Hence, the study confirmed the strain specific potential of *Burkholderia* spp. in triggering the early flowering and fruiting in *C. frutescens* with associated protection from insect attack.

Keywords *Burkholderia* spp. · *Capsicum frutescens* · Field application · *Bemisia tabaci*

Introduction

The remarkable functioning of endophytic bacteria within the plants provides support to plant growth and health. Due to their positive impact on plant growth, they have also been described as plant growth promoting endophytes (PGPEs). Plants are considered to perform stringent selective measures to recruit only those microbes as endophytes which can have tunable mechanisms for plant growth and disease resistance [1]. Hence, the regularly recruited endophytes form a significant part of plant microbiome and they collectively regulate the growth, stress tolerance and nutrient assimilation of plant system. The mechanistic basis of these involves nitrogen fixation, phosphate solubilization, iron chelation, ACC deaminase activity [2, 3], and also production of diverse auxins and cytokinins [4]. Biosynthetically versatile PGPEs also produce antibiotics, toxins, and surface-active compounds to inhibit phytopathogens [5]. Their production of chitinase and β-1,3-glucanase also provide enzymatic means to act on fungal cell wall. Endophytic organisms can also compete physically with pathogens for colonization sites, nutrients, and minerals [6, 7]. Also by directly eliciting the induced systemic resistance, they have been demonstrated to reduce the plant disease very effectively [8]. Endophytic bacteria are also known for their role in regulation of plant turgor pressure, function of stomata and root development. Because of their significant role in phytostimulation, biofertilization, and biocontrol, they have been designated as the second genome of plants [9]. Hence, they have immense applications to engineer plant physiological processes, growth, and yield. However, the global impact of PGPEs and their mechanisms on plant is too complicated as most of the mechanisms can have multiple and interrelated effects. Indole 3-acetic acid (IAA) of microbial origin itself has been considered to enhance the proliferation of root, plant growth [2], activate the plant defense system [10], and also mediate plant microbe interactions [11]. However, in most of the endophytic bacterial study, the overall impact of microorganisms on plant has not been investigated in detail. This is because the global network of events which are being engineered by PGPE in plants can be demonstrated only through in vivo study under natural condition.

In the study, the experiment was designed to identify the collective contribution of various plant beneficial mechanisms

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3 Biotech (2017)7:256
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ORIGINAL ARTICLE

Pseudomonas fluorescens R68 assisted enhancement in growth and fertilizer utilization of *Amaranthus tricolor* (L.)

C. Jimtha John[1] · P. Jishma[1] · N. R. Karthika[2] · K. S. Nidheesh[1] · J. G. Ray[1] · Jyothis Mathew[1] · E. K. Radhakrishnan[1]

Received: 18 February 2017 / Accepted: 11 July 2017

Abstract Plant probiotic potential of rhizosphere microbiome and its role in phytofertilizer mobilization are largely unexplored. In the current study, the rhizobacterium *Pseudomonas fluorescens* R68 (PFR68) isolated from Western Ghat was analyzed for its growth enhancement effect on the leafy vegetable *Amaranthus tricolor* (L.). One month of field growth of PFR68 inoculated *A. tricolor* has found to have enhanced growth parameters such as leaf number (1.57 fold), root number (1.76 fold), shoot length (1.28 fold) and fresh weight (2.31 fold). The treatment also improved soil fertility in terms of Nitrogen, Phosphorus and Potassium content. Most remarkably, application of PFR68 alone and 50% of recommended NPK dose along with PFR68 has resulted in enhanced growth of *A. tricolor* comparable to plants treated with full dose of NPK. In addition to this, application of PFR68 along with 50% NPK augmented the available Nitrogen and Phosphorus content in soil. This indicates the potential of selected organism in enrichment of soil health and enhancement of crop productivity. In conclusion, field performance of PFR68 on growth of *A. tricolor* confirms its promises to develop into plant probiotic formulation.

Keywords Biofertilizer · NPK fertilizer · Nutrient accumulation · Soil nutrient status · *Amaranthus tricolor*

C. Jimtha John and N. R. Karthika contributed equally.

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Introduction

Amaranthus tricolor is one of the most commonly used leafy vegetables in Southern part of India. Cooked leaves of the plant are used along with the main dish of cereals or tubers. The leaves are also dried and powdered to be used in traditional sauces during the dry season. The plant is a good source of iron (38.5 mg/100 g), calcium (350–400 mg/100 g), essential micronutrients, vitamins and various minerals (Beswa et al. 2016). Because of this, development of methods to improve the biomass and yield of the plant in the limited area of cultivation is highly demanding.

Recent trends in plant microbiome have demonstrated the potential impact of plant growth promoting rhizobacteria (PGPR) on growth improvement of plants and fertility of soil (Ahemad and Kibret 2014). Plant growth promotion by PGPR may involve phytostimulation, biofertilization or biocontrol mechanisms (Zahid et al. 2015). The chemical basis of these processes can have enhancing effect on soil fertility also (Figueiredo et al. 2016). The well known plant beneficial features of PGPR involve the production of phytohormones, nitrogen fixation, phytopathogen antagonism, cyanogenesis, phosphate solubilization and ACC deaminase activity (Beneduzi et al. 2012). As microbiological methods for plant growth improvement have tremendous potential to explore, in the current study we have selected leafy vegetable *Amaranthus tricolor* as the plant system.

The excessive and uncontrolled use of chemical fertilizers have resulted in various adverse effects to living systems (Adesemoye and Egamberdieva 2013). Hence, PGPR have significant role to generate environmentally sustainable bioformulations either alone or as supplement with low concentration of fertilizers. Among the various plant growth

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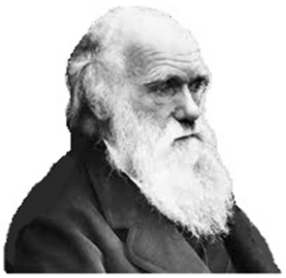

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Endomycorrhizal studies in *Curcuma aeruginosa* Roxb. of Kerala, India

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ABSTRACT

This is the first report of an ecological investigation on endomycorrhizal symbiosis in *Curcuma aeruginosa*, a medicinally and nutritionally important herb. Samples were collected from the field, where the plant grows under natural condition. AM fungal and soil fertility parameters were analysed as per standard methods. Altogether 16 different AM fungal species from seven different soil series are discovered. AM fungal species composition varied among soil series. Species richness of AM fungi was positively correlated with organic carbon content of soil. Shannon's diversity index and Simpson's index in the study area were measured. High intensity of AM fungal colonization in the roots of naturally growing *C. aeruginosa* suggests the need of proper management of the association in its cultivation practices also. Data obtained from the present investigation may help for the development of native AM fungi based biofertilizer based for a sustainable soil fertility management and cultivation of the crop.

Keywords: *Curcuma aeruginosa*, Native AM fungi, Arbuscular mycorrhiza, Ultisols

1. INTRODUCTION

Curcuma aeruginosa (*C. aeruginosa*) is an underutilized herb [1] with many medicinal and nutritional qualities [2]. *C aeruginosa* rhizomes contain 41.85% starch [3], which is used as food by many tribal and native people [4]. *C. aeruginosa* possesses antioxidant [5] and antimicrobial properties [6]. However processing and starch production from various Curcuma species in South India has declined [4] because large scale cultivation of the crop has diminished.

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RESEARCH ARTICLE

Indigenous Knowledge of Plants Used as Medicine by Rengma Naga of Karbi Anglong, Assam

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ABSTRACT

The main goal of the current study is to provide evidence of how the Rengma Naga people of Karbi Anglong, Assam, used plants to treat a variety of illnesses. An intensive Field study was conducted from January 2021 to June 2022. Questionnaires, personal interviews, and group discussions were conducted. Informants were selected randomly belonging to different age groups and gender. The data collected were all from primary sources as there is no written record or documentation on medicinal plants. For the treatment of various ailments and diseases, 40 medicinal plants belonging to 38 genera and 29 families were identified. The families Asteraceae and Zingiberaceae were found to have a maximum number of species used in traditional medicine.

Keywords: Ethno medicine, Indigenous knowledge, Rengma Naga, health care.

INTRODUCTION

Ethnomedicine is the branch of Ethnobotany that focuses on the investigation of plants used by the tribal or indigenous populations to treat different ailments and health disorders. By definition, Indigenous knowledge (IK) of Ethnomedicine implies the long-historical use of plants for medicinal purposes by different communities. It is believed to have evolved over the years through trial and error methods and symbolizes the relationship between

CHAPTER 15

Glomus Microcarpum: A Dominant Arbuscular Mycorrhizal Associate of Banana in South India

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Abstract: An Arbuscular mycorrhizal fungus (AMF) is one of the biodiversity components of soil significant to soil fertility. The AMF is essential for the healthy growthof many plants. In our extensive investigation on the natural AM flora of diverse commercially cultivated banana fields in South India, the AM fungus G*lomus microcarpum* was one of the major root associates of banana. It is associated with all the 13 banana varieties in South India. The spore density of *G. microcarpum* in soil samples ranged from 10 to 510 per 100g soil. Mean spore density in summer season (139.51±9.58) was significantly higher (P<0.0001) than that of monsoon season (91.61±4.73). In relation to banana varieties, the average spore density of *G. microcarpum* in the summer ranged from 20 (*Kadali*) to 185 (*Rasthali)*, and that of monsoon ranged from 30 (*Attukannan)* to138.6 (*Chenkadali*) spores per 100g soil. The difference in spore density over banana varieties was not significant (P>0.05) in both the seasons.The average AM fungal root colonization in banana varieties ranged from 32% to 85%. The mean AM fungal colonization of monsoon season was significantly (P<0.0001) higher than the summer. In general, information on any aspect of natural AMF biodiversity in soils is highly beneficial to sustainable cultivation of any crop.

Keywords: Arbuscular Mycorrhizal Fungi, Banana, *Glomusmicrocarpum*, South India, Sustainable Cultivation.

INTRODUCTION

Arbuscular Mycorrhizal fungi (AMF) represent an important part of the natural soil microbial diversity of terrestrial ecosystems. The AM fungi are common symbiotic associates found in the roots of terrestrial plants, especially many cultivated crops. The beneficial plant-microbe interactions between AM fungi and higher plants determine plant health [1] and they also enrich soil fertility.In general, conservation of biodiversity of AM fungi is highly significant in the maintenance of sustainable agricultural practices.

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CHAPTER
17

Potentials of Indigenous an Fungal Diversity as Means of Sustainable Livelihood for Rural Farmers

Nidheesh K S

Introduction

Arbuscular mycorrhiza (AM) is mutualistic association of fungal species (of the phylum Glomeromycota) and roots of higher plants. They are present in almost 80% of land plants (Bordoloi, Nath, and Shukla 2015). A total of 341 genetically diverse AM fungal species are reported worldwide (Öpik et al. 2013) which represent only a small fraction of the total unexplored AM fungal diversity in nature. The AM fungal associations are already reported in diverse food crops, medicinal plants and forest plants growing in tropical as well as in temperate regions. Irrespective of the diversity and host specificity, AM fungi possess many significant functions in plant growth, rhizosphere microbial diversity and soil fertility.

AM fungi are a major soil biodiversity component, which is inevitable for the healthy growth of crop plants (Manaut et al. 2015). The major roles of AM fungi in plant growth include facilitation of soil mineral nutrient uptake (Ortas 2012), protection of plants from soil borne pathogens (Azcón-Aguilar and Barea 1997), overcoming abiotic stress (Rufyikiri et al. 2000) and synthesis of beneficial phytochemicals (Hristozkova et al. 2016), which contribute to the sustainable production of high quality food.

Diverse methods of food production are currently practiced in the world to meet the ever increasing demand of food for the growing population. However, research outputs on harmful effects of the conventional method of food production using chemical fertilizers, pesticides and herbicides have shown that such methods are detrimental to the general environmental quality and sustainability of soil fertility. Agrochemicals destroy AM fungi and the other soil microbial diversity, which leads to degradation of soil productivity and health. As per the 29th report of the standing committee on agriculture, submitted by ministry of agriculture and farmer's welfare, India's total fertilizer consumption has increased from less than 1 million tons (in the mid sixties) to almost 25.6 million tons in 2014-15. The report says that over dependence of chemical

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Study on the Ethnobotanical Resources Prevalent Among the Rengma Community of Karbi Anglong, Assam, India

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Abstract

The Ethnobotanical study was conducted in two Rengma villages namely Khirang Rengma gaon and Jamerhe Borlangso Rengma Gaon under East Karbi Anglong, Assam during the month of January to December 2022. The Rengmas is one of the hill tribes of Assam living in the valley of Karbi Anglong since 1800 yet no extensive ethnobotanical study was carried out so far. Therefore, the main aim of the study is to document the plant resources used by the Rengma community as edible (Vegetable and fruit), medicine, bio fencing, fodder, construction, fish poisoning and weaving implements. Semi-structured questionnaire, personal interview, and field study method were carried out for the collection of data. The present survey enumerated 62 plant species belonging to 58 genera and 42 families. Majority of the plant species reported were used as vegetables or fruits. 17 species out of 62 were under Least Concern of IUCN Red list threatened species, 3 Data Deficient, 1 Vulnerable and 41 were Not Evaluated against any IUCN criteria.

Key words : Plant resources, Rengma community, Traditional Information, Conservation.

Ethnobotanical resources refer to the Traditional Information (TI) regarding the plants that are culturally, economically, and scientifically significant to humans. Plant resources are the foundation of human knowledge and the core aspect of biodiversity upon which human survival relies. They are the quintessential resources of human

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Article

Microalgae as a source of antimicrobial compounds: A review of bioactive metabolites and their therapeutic potentials

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Abstract: Microalgae, a varied collection of photosynthetic microorganisms, have become a promising source of bioactive compounds known for their antimicrobial properties. These organisms can transform inorganic carbon-di-oxide (CO2) into biomass while producing an extensive range of primary and secondary metabolites, such as proteins, polysaccharides, lipids, pigments, and polyphenols, that demonstrate antibacterial, antiviral, antifungal, and antiprotozoal effects. As antibiotic-resistant microbes are on the rise, there is an urgent need to explore new treatment options. Microalgae, which have been largely overlooked, could be a promising source of novel antimicrobial compounds. Here, we review microalgae-derived substances that fight off various pathogens, including Gram-positive and Gram- negative bacteria, fungi, viruses, and protozoa. Early findings are promising, but more research is needed to fully understand these compounds, improve their production, and confirm their safety and efficacy in real-world medical use. The review highlights the potential of microalgae as a key tool in fighting infections and calls for continued research into their bioactive properties.

Keywords: Microalgae; Antimicrobial Compounds; Bioactive Metabolites; Antibiotic Resistance; Therapeutic Potential

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