ADVANCED TECHNIQUES FOR IMPROVEMENT OF PLANT GROWTH AND HEALTH USING SOIL MICROORGANISMS

NSQF Level: 6
SECTOR: Agriculture
ELIGIBILITY: Bachelor's degree in any Science stream
FEES: Tuition Fees- Rs 3000/- (Rs 100/- per credit)-30 credits
Laboratory Fees- Rs 2000/-(Rs 2000/- per Semester)
Total Fees- Rs 5000/-
CERTIFICATE COURSE: 6 months (450 hours)
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Background

Soils are a rich source of microorganisms like bacteria, fungi, actinomycetes, protozoa and algae. These microorganisms play an important role in regulating the diversity, growth and health of plants. Biological organisms have advantages over chemicals because they can reproduce and have long lasting interactions with plants in agroecosystems. Progressive farmers are turning towards biological sources to improve crop yields and to control plant pathogens and pests. Many biologicals are commercially available and their use is increasing day by day as farmers move from chemical-based agriculture to sustainable agriculture. Given the large variation in soils seen in different regions, there is a large repertoire of microorganisms that are waiting to be put to use in improved agricultural practices. Soil microorganisms also play an important role in restoring contaminated soils and enriching them to support plant growth.

Objectives

1. To train students in techniques pertaining to isolation of soil microorganisms, their culture and identification.
2. To familiarize them with methods of studying the role of soil microorganisms in improving soil composition, plant growth and plant health.
3. To encourage students to develop innovative formulations based on soil microorganisms to improve crop productivity.

Course content

The course would be a certificate course of 30 credits and would consist of three components
a. Theory – 10 Credits
b. Laboratory practicals – 10 Credits
c. Field experiments / projects – 10 Credits

Theory – 10 credits
The course would consist of the following modules
Module 1: Soil microorganisms - their classification, methods of isolation and identification (2 credits). Culture of soil microorganisms
Module 2: Role of soil microorganisms in improving nutrient availability to plants (1 credit)
Module 3: Role of soil microorganisms in providing plant growth regulators (1 credit)
Module 4: Role of soil microorganisms in improving plant immunity against pathogens and pests (1 credit)

Module 5: Soil microorganisms as biocontrol agents against weeds, pathogens and pests (1 credit)
Module 6: Role of soil microorganisms in improving tolerance of plants to abiotic stress (1 credit)
Module 7: Endophytes and their role in improving plant growth and health (1 credit)
Module 8: Soil microorganisms in remediation of contaminated soils (1 credit)
Module 9: Formulations of soil microorganisms and methods of application (1 credit)

Laboratory practicals – 10 credits
Module 1: Isolation of microorganisms from soil and obtaining axenic cultures or soil based inocula
Module 2: Classification of soil microorganisms using DNA sequence information
Module 3: Studying the role of symbiotic and non-symbiotic bacteria increasing nitrogen availability of soil /plant – Estimation of total nitrogen in soil and plant organs, expression of plant genes related to nitrate, ammonium uptake and metabolism
Module 4: Studying the role of arbuscular mycorrhizal associations in improving phosphate availability to plants – Growth of plants on phosphate rich and phosphate poor soils. Effect of mycorrhizal colonisation on plant growth in these two types of soils. Expression of phosphate transporters in roots in response to mycorrhizal colonization
Module 5: Studying the priming effects of different soil microorganisms in improving immune responses in plants against pathogens – estimating levels of defense related plant hormones and chemicals in plants associated with mycorrhizae, other non-pathogenic fungi like *Trichoderma viridae* or non-pathogenic strains of bacteria belonging to *Pseudomonas* spp. Studying expression of defense genes in response to pathogen application to the primed and non-primed plants
Module 6: Studying the effect of soil microorganisms on inhibition of growth of plant pathogens *in vitro* by co-culturing the two organisms. Effect of soil microorganisms in inhibiting growth of plant nematodes
Module 7: Studying bioremediation of saline soils or heavy metal contaminated soils by microorganisms – Estimating salt, or heavy metal content of soil to which different soil microorganisms have been added.

Field experiments – 10 Credits
Students would carry out a 'proof of concept' project under the supervision of mentors drawn from different fields using the training imparted to them in practicals.

Learning outcomes

1. Students will be equipped with knowledge and skills to experiment with soil microorganisms in their own regions and come up with innovative solutions for improving crop productivity without the use of chemicals.
2. This course would nurture a trend towards sustainable agricultural practices, which would benefit small land holders and decrease the costs involved in chemical-based agriculture.
3. Students would be enabled to develop products or formulations using soil microorganisms as a commercial activity.

Industry / NGO Collaboration
There are many Industries and NGOs in Pune who are in this business of using microorganisms for improving soil and plant growth and health. Persons from industries and NGOs who will be included in this program as mentors.

S.NO.	NAME OF FACULTY	AFFILIATED DEPARTMENT
1.	Dr. Ritu Sharma	BAIF, Pune
2	Dr. Dr. Hemlata Kotkar	Agrosecret, Pune
3	Dr. Prashant Mendki	Agrosecret, Pune
4	Dr. Santosh Talegaonkar	Biotricks Biotech, Nasik

5	Mr. Yogesh B. Yadav	SMS- soil science, KVK Narayangaon
6	Mr. Ranajeet Shanbhag	Project Manager, Vigyan Ashram, Pabal
7	Dr. B. P. Kapadnis	Dept of Microbiology, SPPU
8	Dr. N. B. Pawar	Prof. Agriculture College, Pune (retd.)
9	Dr. Abhishek Cukkemane	Chief Scientific Officer, IDEA Discovery Lab, Pune
10	Dr. Digambar Mokat	Department of Botany, SPPU
11	Dr. Mahesh Borde	Department of Botany, SPPU
12	Dr. B.G. Meshram	Department of Botany, SPPU
13	Dr. K. M. Kodam	Department of Chemistry, SPPU
14	Raju Bhai Gandhi	Vigyan Ashram, Pabal
15	Sunil Kulkarni	Vigyan Ashram, Pabal
16	Dr. A.B. Ade	Dept of Botany, SPPU
17	Dr. Neeru Jain	Privi LifeSciences, Mumbai
18	Dr. Richa Nair	Aria Life, Pune