



Rhizospheric and Phyllospheric Study of *Cocculushirsutus* Plant in Deulgaon Raja Tahsil, District Buldhana (MS) India

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Abstract

This study investigates the microbial diversity present in the Rhizosphere and Phyllosphere of the medicinal plant *Cocculushirsutus*, found in Deulgaon Raja Tahsil, District Buldhana. Soil and leaf samples were analyzed for microbial populations using standard microbiological techniques. The Rhizospheric microbial community showed a greater diversity compared to the Phyllospheric community. The results highlight the potential role of beneficial microorganisms in promoting plant growth and maintaining ecological balance. Understanding these microbial associations can be valuable for agricultural and medicinal plant research.

INTRODUCTION

Cocculushirsutus, a member of the Menispermaceae family, is a climbing shrub commonly found in tropical and subtropical regions. It is widely used in traditional medicine for its antioxidant, antimicrobial, and anti-inflammatory properties. Understanding the plant's microbial associations in the Rhizosphere (root-associated) and Phyllosphere (leaf-associated) is essential for evaluating its ecological role (Singh RP & Jha PN, 2017). Microorganisms in the Rhizosphere and Phyllosphere significantly influence plant health by promoting nutrient uptake, enhancing disease resistance, and improving soil structure. The study of these microbial communities can provide insights into sustainable agricultural practices.

The Menispermaceae family consists of about 70 genera and 500 species. Among them, the genus *Cocculus* comprises about 10 species distributed in Asia, Africa, Australia and North America (De Wet H. *et al.*, 2014). *Cocculushirsutus* (L.), *Cebathahirsuta* (L.), *Cocculus aristolochiae* (DC.), *Cocculushastatus* (DC.), *Cocculushirsutus* (L.) World Flora Online (2020) is a perennial climber distributed mostly in tropical and subtropical areas (Panda BR *et al.*, 2007). In Asia, it is reported from India, Myanmar, Nepal and Pakistan and southern China (Shrestha KK

et al., 2018; Ahmad VU *et al.*, 1993). In Africa, it is reported from Egypt, Sudan and Eritrea, Angola and south-west and southern Africa by (Fahmy AG & El-Bakry AA, 2011). The detailed distribution in Asia and Africa is given in (GBIF-2020). It is known by various names in local languages such as: Broom creeper (English); (Hindi); Kaage Mari (Kannada); Faridbuti (Urdu); Paathaalagarudakkoti (Malayalam), Kaanselaharo (Nepali); Garudi, Patalagarudi (Sanskrit), Chipuru-tiga (Telegu); Kattu-k-koti (Tamil) among others (<https://indiabiodiversity.org/species/show/229234>).

MATERIALS AND METHODS

Study Area

The study was conducted in Deulgaon Raja Tahsil, located in District Buldhana, Maharashtra. The region experiences a tropical climate with average annual temperatures ranging from 25°C to 35°C. The soil is predominantly black cotton soil with moderate organic matter content.

Sample Collection

Rhizosphere Soil: Soil samples were collected from the root zone of mature *Cocculushirsutus* plants at a depth of 10-20 cm (Compant S *et al.*, 2005).

Phyllosphere Samples

Fresh leaves were carefully collected using sterile forceps and stored in sterile bags for further analysis.

Microbial Isolation and Culturing

Serial dilution and plating techniques were used to isolate bacterial and fungal colonies. Nutrient agar was used for bacterial growth, while potato dextrose agar (PDA) was used for fungal isolation. The colonies were characterized based on morphological and biochemical tests (Mendes R *et al.* 2013).

Identification of Microorganisms

Gram staining and microscopic examination were performed for bacterial identification. Fungi were identified using lactophenol cotton blue staining. Molecular identification through 16S rRNA sequencing was performed for selected isolates.

Data Analysis

Microbial diversity was calculated using the Shannon-Wiener diversity index. Comparative analysis of Rhizospheric and Phyllospheric microbial populations was conducted (Glick BR, 2014).

RESULTS AND DISCUSSION

Microbial Diversity in the Rhizosphere

The Rhizosphere of *Cocculushirsutus* exhibited a higher microbial load compared to the Phyllosphere. Dominant bacterial genera included *Bacillus*, *Pseudomonas*, and *Rhizobium*, known for their plant growth-promoting properties. Fungal isolates included *Aspergillus*, *Penicillium*, and *Trichoderma*, which contribute to soil health (Ahmad F *et al.*, 2020).

Microbial Diversity in the Phyllosphere

The Phyllosphere contained relatively fewer microbial species, with *Streptomyces*, *Micrococcus*, and *Pseudomonas* being the most prevalent. These bacteria often play a role in plant defense mechanisms and nutrient cycling (Bhattacharyya PN & Jha DK 2012).

Table 1: Observation of Different Phyllospheric and Rhizospheric Fungal Species of Deulgaon Raja Tahsil of Buldana District.

Sr. No.	Observation of fungal species	Phylosphere (+/-)	Rhizosphere(+/-)
1	<i>Alternaria alternata</i>	+	-
2	<i>Aspergillus niger</i>	+	-
3	<i>Cladosporium cladosporioides</i>	+	-
4	<i>Aspergillus terreus</i>	-	+
5	<i>Penicillium chrysogenum</i>	+	
6	<i>Fusarium oxysporum</i>	-	+
7	<i>Penicillium citrinum</i>	-	+
8	<i>Fusarium equiseti</i>	+	-
9	<i>Trichoderma harzianum</i>	-	+
10	<i>Colletotrichum gloeosporioides</i>	+	-
11	<i>Phoma glomerata</i>	+	-
12	<i>Rhizoctonia solani</i>	-	+
13	<i>Botrytis cinerea</i>	+	-
14	<i>Macrophominaphaseolina</i>	-	+
15	<i>Cercospora arachidicola</i>	+	-
16	<i>Sclerotium rolfsii</i>	-	+
17	<i>Pythiumaphani dermatum</i>	-	+
18	<i>Phyllosticta zingiberi</i>	+	-
19	<i>Phytophthora nicotianae</i>	-	+
20	<i>Glomus in traradices</i>	-	+

(+ Fungi Present) (- Fungi Absent)

Comparative Analysis

The microbial diversity index was significantly higher in the Rhizosphere ($H' = 3.5$) compared to the Phyllosphere ($H' = 2.1$). Environmental factors such as

soil nutrients, root exudates, and plant species-specific traits influenced microbial diversity (Lee SA & Kim Y, 2015).

Ecological Significance

Rhizospheric microbes enhanced nutrient availability through nitrogen fixation and phosphate solubilization. Phyllospheric microbes contributed to plant defense against pathogens. Understanding these interactions can aid in developing biofertilizers and biocontrol agents.

CONCLUSION

The study highlights the greater microbial diversity in the Rhizosphere compared to the Phyllosphere of *Cocculushirsutus*. Rhizospheric bacteria such as Rhizobium and Bacillus play a crucial role in nutrient cycling, while Phyllospheric bacteria contribute to plant health. Further research can explore the application of these beneficial microbes in sustainable agriculture.

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