

ARBUSCULAR MYCORRHIZAL STATUS OF SOME ETHNOMEDICINAL AND MEDICINAL PLANTS OF PASCHIM MEDINIPUR

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ABSTRACT:

Paschim Medinipur district is rich in ethno medicinal flora. Arbuscular mycorrhizae (AM) are obligate symbiotic fungi which activates nutrient and water uptake in plants. A survey was conducted to evaluate the Arbuscular mycorrhizal status of ethno-medicinal plant species from lateritic belt of Jhargram, Garhbeta and Midnapore subdivisions. Root and rhizospheric soil samples were investigated for arbuscular mycorrhizal colonization and AM spore. Species belonging to the families Poaceae, Lamiaceae, Meliaceae and Papilionaceae showed maximum colonization with high intensity class and presence of arbuscular vesicles. Species with wide distribution showed comparatively high colonization than locally confined species. So status may be related to their availability, though some tendency of host preference was noticed.

Keywords: Arbuscle, Intensity class, Lateritic soil, Mycorrhizal colonization, Vesicle.

1. Introduction

Medicinal plants are well natural resource of beneficial chemicals used for drug development. Traditional healthcare practices of indigenous people pertaining to human health are termed as ethno-medicine and their demand has been increasing rapidly in healthcare and pharmaceutical industry. In different regions of the world more than 35000 medicinal plant species are used as medicine [19]. Lateritic belt of Paschim Medinipur district is rich in different medicinal plants. This region is also ethno-botanically rich. The ethnic communities in Paschim Medinipur contains about 17.5 % population of this district is largest in Bengal [12] and they have valuable traditional ethnobotanical knowledge of their own.

Root–fungus association is called Mycorrhiza that evolved with land plants [9]. Mycorrhization occur when obligate symbiotic association prevails between a plant and nonpathogenic fungi that colonizes in the cortical tissue of roots during periods of active plant growth [16]. Arbuscular Mycorrhizal fungi (AMF) draws 30% of photosynthates from plant for its own survival and in exchange provides plants nutrients; especially, phosphorous along with nitrogen and trace elements. AM hyphae procure nutrient form beyond the nutrition depletion zone of roots [20] and form mycelial mats to retain moisture. AM fungal mycelia are able to absorb water from lower water potential than the roots [5]. They also protect plants from pathogenic fungi and nematode disease [3]. AM symbiotic relationship found in almost 80% of land plants [28]; though AM dependency varies with soil and plants [30]. Lateritic soil is deficient in Phosphorus. AM are well known to enhance the P-uptake of plants growing under P-poor conditions [7, 32, 24] and helps to improve water and nutrient uptake, enduring in drought [2, 6, 29].

Present survey was conducted to study and compare the AM colonization status in ethno-medicinal plants and distribution of these plants in lateritic belt of Paschim Medinipur district.



2. Materials and Methods

Sampling of the plant species were done from acidic soil zone in Jhargram, Garhbeta and Midnapore subdivisions of Paschim Medinipur district (22.30° N and 87.20° E) of south West Bengal, India.

Rhizospheric soil and root samples of different medicinal plants were collected in three composite replicates in pre-winter season. Root colonization percentage was measured by following Phillips and Hayman's method [23] and intensity class was measured [18]. 50 root pieces were examined for each

sample and root colonization percentage was calculated by the formula:

$$\text{Root colonisation percentage} = \frac{\text{No. of root pieces colonised}}{\text{Total No. of root pieces observed}} \times 100$$

Spores was decanted and isolated according to Gerderman and Nicolson [10].Based upon hyphal attachment, colour, size, shape, structure and compound microscopic character spores were identified. Identification and nomenclature was done according to Schenck and Perez [27].

Identification and use of the ethno-medicinal plants was done by following Medicinal plant resources of South West Bengal [21]and Bengal Plants, vol. 1 &2 [25]. The collected soil samples were lateritic in nature. Soil samples were tested for average pH, EC, moisture content, organic carbon (OC), nitrogen, phosphorus, potassium according to Jackson [14].

TABLE 1:Average soil character instudy area:

Parameters	Average reading
pH	5.4-5.7
Ec (m.mohs/cm ²)	0.18
Moisture Content %	1.9-2.8
Organic Carbon (g kg ⁻¹)	0.97-1.23
Nitrogen %	0.0491
Phosphate %	0.0418
Potassium %	0.095

3. Results and Discussion

The lateritic soil is poor in NPK and moisture content and acidic in nature (Table 1). All of forty collected ethnomedicinal plants were found mycorrhizal. Maximum mycorrhizal colonization was found in *Cymbopogon citrates* (89%) of poaceae followed by *Occimum sanctum* (87%)and*Occimumtenuiflorum*(84%)ofLamiaceae, *Azadirachtaindica*(85%) of Meliaceae and*Clitoriaternatea* (82%) of Fabaceae. Good colonization (48-67%) was found in families like Apocyanaceae, Euphorbiaceae, Solanaceae, and Moraceae. Vesicle was found in both members of the family Euphorbiaceae. Plants belonging to same families showed variations in arbuscular, vesicular and total colonization and intensity class. Minimum colonization % was found in *Bacopamonneri*(11%) followed by *Marsileaminuta* (15%), *Centellaasiatica* (16%), and *Bryophyllumpinnatum*(18%); the last belongs to a family poorly mycotropic. Maximum intensity class (III) with vesicle and arbuscle was found in all members studied in Lamiaceae family. Colonisation in *Bacopamonneri* (11%) from Scrophularaceae,*Marsileaminuta*(15%) from Marsileaceae, and *Centellaasiatica* (16%) from Umbelliferae family was found minimum. That was may be due to they are confined in moist habitat [15]. So their AM dependency was normally low. Plants those are common and widespread showed high colonization rather those in microhabitat. Hence AM dependency may have influence in distribution of plants.

Better colonisation has been reported in several families like Fabaceae, Lamiaceae and Graminae[26, 13, 11]. Members of same family may also show variation to AM response [11].

As the soil in the sampling zone is mainly acid lateritic, the soil is deficient in phosphorus as well as nitrogen and other less mobile nutrients for slow nutrient cycling [17]. The soil is also moisture deficient. In this condition plants depended more on mycorrhizae for nutrients and moisture as AM are more active in nutrient poor dry soils [7]. AM species in form of spores belongs to the genera *Acaulospora*, *Glomus*, *Gigaspora* and *Scutellospora* were found in rhizosphere. From different locations total 21 species (approx) were found; dominated by *Acaulospora* and *Gigaspora*. These genera are normally found in acidic and sandy soil and it has been reported that some AM isolates of these genera are found effective in overcoming soil acidity factors, especially Aluminium toxicity that restrict plant growth at low pH [8]. AM has roles in alleviation of stress in acid soil [22]. Presence of arbuscular colonization indicates active symbiosis among the two [13]. High intensity class indicates high dependency of plants on AM. Even the poorly mycotropic plants also showed optimum AM colonization.

Arbuscular mycorrhizal symbiosis may play direct or indirect role in these ethnomedicinal plants to improve their medicinal ingredients [1] by providing nutrients in natural environment of lateritic zone of Paschim Medinipur. Studies in agriculture, forestry, horticulture and restoration ecology emphasize that mycorrhizal management improves plant survival and growth [4, 31]. For large scale cultivation this outcome may help. High intensity class indicates high dependency of plants on AM. Even the poorly mycotropic plants also showed optimum AM colonization.

TABLE 2 : Ethnomedicinal plants and their distribution, use and mycorrhizal status:

Family, Botanical / Bengali Name	AM Status				Ab	Ethnobotanical/ Medicinal Use
	C	A	V	I		
Acanthaceae						
1. <i>Andrographispaniculata</i> Wall. ex Nees. Kalmegh	67	+	+	II	R	1. Leaves consumed to improve digestion and liver function. 2. Whole plant used in general debility, leprosy, taken to cure scab.
2. <i>Adhatodavasica</i> Nees. Basak	48	+	-	II	C	1. Leaves useful to treat chronic bronchitis, cold and cough, rheumatism, asthma, diarrhea etc. 2. Bark useful in acidity, heart diseases.
Apiaceae						
3. <i>Foeniculumvulgare</i> Mill. Mouri	55	-	-	I	R	Fruits are useful for acidity, burning micturition and amoebiasis.

Apocynaceae						
4. <i>Alstoniascholaris</i> R.Br. Chhatim	62	+	-	II	C	1. Bark extract used as tonic in chronic diarrhea, asthma, cardiac troubles. 2. Leaves used in beriberi, dropsy. 3. Latex applied to cure dental caries, disentry.
5. <i>Catharanthusroseus</i> (L.) G. Don. Nayantara	57	+	-	II	C	1. Entire plant used to improve memory, diabetes mellitus, high blood pressure etc. 2. Latex applied to cure cancerous wounds. 3. Roots used to treat asthma and cancer.
Apocynaceae						
6. <i>Rauwolfiaserpentine</i> (L.) Benth. exKurz. Sarpagandha	51	+	+	II	R	1. Root extract is useful in snakebite and high blood pressure. 2. Pasted root is applied in abdominal pain.
Aristolochiaceae						
7. <i>Aristolochiaindica</i> Linn. Ishwarmul	46	+	-	II	R	1. Root paste used in abdominal pain. 2. Leaves used as antidote to snakebite. 3. Seed powder used to remove dry cough.
Asclepiadaceae						
8. <i>Hemidesmusindicus</i> L. R.Br. Anantmul	41	+	-	II	R	1. Root used in kidney troubles, fever, skin diseases, ulcer etc. 2. Root paste is applied on the bitten areas.
9. <i>Calotropis gigantean</i> (L.) R.Br. ex Ait. Akanda	53	+	+	II	C	1. Latex used to treat wounds caused by poisonous insects, cure teeth gum pain. 2. Roots used to cure leprotic wounds, abdominal tumours etc.
Boraginaceae						
10. <i>Heliotropiumindicum</i> Linn. Hatisur	49	+	+	II	R	1. Crushed root taken to treat snakebite, applied to treat ringworm. 2. Leaves useful in typhoid fever, eczema, eye infection etc.

Caesalpineaceae						
11. <i>Cassiaalata</i> Linn. Dadmari	45	+	-	II	C	1. Leaves applied to treat ringworm, leprosy etc. 2. Leaves used to treat cough, asthma etc.
12. <i>Tamarindusindicus</i> Linn. Tentul	56	+	+	III	C	1. Leave juice used in ulcer, rheumatic pain, pox, dysentery etc. 2.Ripe fruit used as digestive and liver tonic etc. 3. Seed extract used in diabetes and snake bite.
Crassulaceae						
13. <i>Bryophyllumpinnatum</i> (Lam.) Kruz. Patharkuchi	18	-	-	I	M	1. Leaves used to treat diabetes and cold and cough. 2. Leaves useful hysteria, hematemesis etc.
Euphorbiaceae						
14. <i>Achryanthesaspera</i> Linn. Apang	56	+	-	II	C	1. Roots used to cure allergy and abdominal pain. 2. Entire plant used in dysentery, blood diseases etc.
15. <i>Euphorbianerifolia</i> Linn. Mansa	49	+	+	III	R	1. Fresh latex applied as antidote to snake and poisonous insect bites. 2. Whole plant useful in abdominal troubles, bronchitis, tumours, anaemia, ulcer etc.
16. <i>Emblica officinalis</i> Linn. Amlaki	58	+	+	II	C	1. Fruits used to treat vomiting, inflammation, anaemia, indigestion, dandruff etc. 2. Leave extract used in ophthalmia.
Lamiaceae(Labiataeae)						
17. <i>Leucasplukenetii</i> (Roth.) Spreng. Dronpuspa	81	+	+	III	C	1. Leaves used as digestive, antibacterial, antipyretic. 2. Flowers taken to treat cough and colds.
18. <i>Occimum sanctum</i> Linn. RudraTulsi	87	+	+	III	C	1. Leaves used to treat bronchitis, ring worm, blood purifier, reduce unwanted body spot. 2. Act as antibacterial.

19. <i>Occimum tenuiflorum</i> Linn. Krishna Tulsi	84	+	+	III	C	<ol style="list-style-type: none"> 1. Whole plant, leave and seeds used as digestive, stomachic, vermifuge, alexeteric. 2. Useful in haemopathy, cardiopathy, asthma, bronchitis, skin diseases etc. 3. Roots used in malarial fever.
Liliaceae						
20. <i>Aloe barbadensis</i> Mill. <i>Aloevera</i> (L.) Burm. f. Ghritakumari	38	+	-	I	M	<ol style="list-style-type: none"> 1. Leave juice used in dyspepsia, acidity, abdominal tumours, eczema, diarrhea etc. 2. Leave gel used in skin and hair treatments.
21. <i>Allium sativum</i> Linn. Rasun	24	+	-	II	C	<ol style="list-style-type: none"> 1. Bulb paste applied in common cold, fever, cough, malaise. 2. Oil extract from bulb used in rheumatism. 3. Intake of bulb useful in acidity.
Marsileaceae						
22. <i>Marsilea minuta</i> Linn. Shushni	15	-	-	I	M	<ol style="list-style-type: none"> 1. Leaves used to cure insomnia. 2. Juice from crushed rhizome in applicable in abdominal pain.
Meliaceae						
23. <i>Azadirachta indica</i> A. Juss. Neem	85	+	+	III	C	<ol style="list-style-type: none"> 1. Leaves used to cure skin diseases, septic wounds, blood purifier, diabetes, leprosy, pox etc. 2. Seed oil applied on skin diseases, ringworm, ulcer, rheumatism etc. 3. Bark used in inflammation, fever, toothache, blood complaints etc.
Mimosaceae						
24. <i>Acacia farnesiana</i> (L.) Wild. ex Delile. Babla	66	+	+	III	C	<ol style="list-style-type: none"> 1. Bark used as astringent. 2. Heartwood used to treat diabetes. 3. Flowers used to treat haemoptysis. 4. Gum obtained from wounded stem bark in belly pain.

25. <i>Mimosapudica</i> Linn. Lajjabati	29	+	-	II	C	1. Roots used to treat leprosy, asthma, blood diseases etc. 2. Leave juice applied to stop bleeding.
Moraceae						
26. <i>Ficusbenghalensis</i> Linn. Bat	69	+	+	III	C	1. Pasted soft roots are applied in belly pain. 2. Latex used in chronic amoebiasis.
Moringaceae						
27. <i>Moringaoleifera</i> Lam. Sajna	38	+	-	III	C	1. Leaves and fruits used as vegetables to prevent Chickenpox. 2. Root bark paste applied in traumatic swelling & rheumatism.
Papaveraceae						
28. <i>Argemonemexicana</i> Linn. ShialKanta	47	+	+	III	C	1. Roots used in skin disease. 2. Whole plant used to treat eye disease, leprosy, boils, bloody urine, rat bite etc.
Papilionaceae(Fabaceae)						
29. <i>Clitoriaternatea</i> Linn. Aparajita	82	+	+	III	C	1. Leave, stem, roots used as brain tonic, used to treat hysteria. 2. Root bark used to remove dry cough.
Poaceae(Gramineae)						
30. <i>Cymbopogoncitrates</i> Stapf. Dhanwantari	89	+	+	III	R	1. Leaf oil useful in gastric irritability, cholera, chronic rheumatism etc. 2. Grass and roots used to treat bronchitis, leprosy, dyspepsia etc.
31. <i>Cynodondactylon</i> (Linn.) Pers. Durba	59	-	-	I	C	1. Crushed leaf applied to cut and wounds. 2. Leave juice is useful in empty stomach to cure belly pain. 3. Leaf extract used to prevent hair loss, hair ripening.
Rubiaceae						
32. <i>Paederiafoetida</i> Linn. Gandal	31	+	-	II	M	Leaves used in diarrhoea, amoebiasis and dysentery.

Rutaceae						
33. <i>Aeglemarmelos</i> Corr. ex Roxb. Bel	77	+	+	III	C	1. Roots used in fever, abdominal pain. 2. Root bark taken in case of snakebites. 3. Ripe fruits used as tonic, good for heart and brain.
Scrophularaceae						
34. <i>Bacopamonnieri</i> Pennell. Brahmi	11	-	-	I	M	1. Leaves juice is useful to improve memory. 2. Stem and leave extract applied in hair treatment.
Solanaceae						
35. <i>Daturamete</i> Linn. Dhutra	44	+	+	II	C	1. Extract of roots are taken with garlic in snake bite. 2. Crushed leaves are used on the traumatic pain.
36. <i>Winthiasomnifera</i> (L.) Dunal. Ashwagandha	48	+	-	II	R	1. Root is applied on snakebite. 2. Leaves used in carbuncles, scabies etc.
Umbelliferae (Apiaceae)						
37. <i>Centellaasiatica</i> Linn. Thankuni	16	-	-	I	M	1. Leaves juice is useful in amoebiasis dysentery and diarrhoea. 2. Crushed leave applied in indigestion and fever.
Verbenaceae						
38. <i>Vitex negundo</i> Linn. Nishinda	38	+	-	II	C	1. Leaf juice used to improve memory, to treat fever and gout. 2. Root extract is given with warm water in colic and dyspepsia.
Zingiberaceae						
39. <i>Curcuma longa</i> Linn. Halud	35	+	-	II	C	1. Rhizome intake in diabetes and skin diseases. 2. Dried rhizome paste applied in chronic amoebiasis. 3. Paste of rhizome applied in traumatic swelling.

40. <i>Zingiberofficinale</i> Rosc. Ada	29	+	-	I	C	1. Rhizome paste useful in sore throat. 2. Rhizome extract applied in cough, tonsillitis.
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Note: AM= Arbuscular Mycorrhizal; C= Colonisation %; A= Arbuscle present; V= Vesicle present; I= Intensity Class; Ab= Abundance; C= Common and widespread; R =Common but not widespread; M= In microhabitat.

4. Conclusion

Mycorrhizal affinity and dependency of plant species is strongly related to their distribution rather than their family, though family of plants also important for intensity of mycorrhization. Soil type is also important factor.

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