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Ethnobotanical uses and studies of vesicular arbuscular mycorrhiza in the potential herbal medicinal plant ‘*Aloe vera* (L.) Burm. f’

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Abstract

Aloe vera is a well known traditional medicinal plant cultivated throughout the world for different medicinal and commercial purpose. The plant *Aloe* is used for curing several diseases mainly connected with digestive system. The present study is the assessment of vesicular-arbuscular mycorrhizal root colonization in two different districts, one from the hill area and another from land. They show around 95.5% root colonization in both areas averagely. In the root both vesicles and arbuscules were observed and spores are abundant from the both rhizospheric soil sample. Both the rhizospheric soils were dominated by *Glomus* species.

Keywords: Digestive system, vesicular-arbuscular mycorrhiza, *Glomus*

1. Introduction

Aloe vera (L.) is a species of *Aloe* which is one of the most important xerophytic plants having potential medicinal value and originated from the East Africa and in the Mediterranean region. Now the species has been widely cultivated throughout the world. *Aloe vera* is the oldest medicinal plant ever known and the most applied medicinal plant worldwide. Extract of this plant has antibiotic, antiseptic and medicinal properties used for curing different diseases. *Aloe vera* is rich in anthraquinones^[1, 2] vitamin-A, B1, B2, B6, B12, choline, folic acid^[3, 4], enzymes, minerals, amino acids, fatty acids and natural sugars^[5, 6].

A. vera forms arbuscular mycorrhizal colonization for better growth and access of mineral nutrition from the rhizospheric soil. *Aloe vera* (L.) is a perennial, xerophytic, succulent plant belongs to the family Aloaceae. The plant is stem-less or very short stemmed growing to 60-100 cm tall, spreading by offsets. The leaf-margin is serrated and contains small white teeth. The flowers are growing in the season of summer on spike up to 90 cm. tall, each flower being pendulous, with a yellow tubular corolla and 2–3 cm long. The plant *Aloe* is a xerophytic plant because they show crassulacean acid metabolic (CAM) pathway for the storage of water in their parenchymatous tissues that can withstand drought. *Aloe vera* has been used for more than 5,000 years and found in numerous civilizations. It is one of the ancient herbal medicinal plants used in traditional Chinese medicine and Ayurvedic medicine in India. In Ayurveda *Aloe* is known as “Ghritakumari”. It is believed that this plant brings back youthful energy and femininity to the women. *Aloe vera* juice is one of the finest body cleansers and also used as a tonic for the female reproductive system. *Aloe* is said to have all three kinds of Ayurvedic constitutions Vatta, Pitta and Kapha^[7, 8]. The plant has healing and soothing effect for the relief of indigestion, stomach distress and ulcers. It is also used in the traditional herbal medicine for constipation, arthritis, bladder and kidney infections, skin diseases, heat burn, leg cramps, diverticular disorders, Diabetes, Cancer, hemorrhoids, insomnia, and for vaginitis^[9]. It is responsible for the increase of white blood cell production in blood. Often *Aloe* in combination with liquorice root treated for the disease eczema or psoriasis^[7, 8]. *Aloe vera* gel stimulates the production of collagen and prevents aging of skin, lightens the dark spots on the face, reduces pigmentation, removed dead skin cells and rejuvenates the skin. *A. vera* is used in the production of soaps, shampoos, beauty creams and lotions for the commercial purposes. The arbuscular mycorrhizal (AM) symbiosis refers to an association between plant roots and fungi. The AM fungi are obligatory biotrophic in nature. They show a mutualistic behavior characterized by a bidirectional nutrient exchange. Arbuscular mycorrhizal symbiosis is responsible for the increase in nutritional uptake and growth of horticultural plants. Extension of extraradical hyphae of mycorrhizal fungi into soil increases the surface area for nutrient uptake and, therefore, increases uptake of phosphorus and other nutrients that is often depleted in rhizosphere soil solution^[10]. Many plant species in Liliales, to which Aloes belong,

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are known to be mycorrhiza-dependent^[11]. Keeping this view in mind, is to compare the vesicular-arbuscular mycorrhizal (VAM) colonization in *A. vera* in plane land and hill areas like Darjeeling district to determine the population of VAM spore in rhizospheric soil spore.

2. Materials and methods

2.1 Selection of plants

A. vera of Aloaceae family growing mainly in hill area of Darjeeling district and plane area of Burdwan district, West Bengal, India have been selected for the study.

2.2 Identification of plant

The plants were identified by using published literature and the herbarium of Botany Department, Burdwan University, Burdwan and arranged according to Bentham and Hooker's system of classification (Voucher specimens: Golapbug, Abhinanda Ghosh 31 (BURD) and Siliguri, Tamal Mondal 18 (DARJ).

2.3 Root clearing method for VAM colonization

This study was conducted in the Botany department, The University of Burdwan, Burdwan, West Bengal. Fine roots of *Aloe vera* were collected from the University campus, Burdwan and Darjeeling. Here we represent a comparative study of mycorrhizal association between the plane land and hill area of this succulent plant species. Fine terminal roots were collected of this plant. Collected roots were gently washed under tap water and cut into segments approximately 1 cm. in length. Root clearing method^[12] was followed to stain the roots. The root samples were placed in the test tubes in which 10% KOH solution was added. Then the test tubes were heated for half an hour in a water bath. After heating, the KOH solution was poured off from the test tube and roots were rinsed with distilled water for several times. Roots were placed in 1% HCL solution for 5 minute to acidify them and were again rinsed with distilled water & then stained with 0.05% Trypan blue. The excess stain was removed by washing with lactophenol and the root segments were temporarily mounted on the slide by using lactophenol and the edges of the cover slips were sealed with DPX and observed under the microscope (Leica DMLB-3000). Percentage of VAM colonization was calculated by using Nicolson simple formula^[13].

$$\text{Colonization (\%)} = \frac{\text{No. of root segments colonized with VAM}}{\text{Total no. of root segments observed}} \times 100$$

2.4 Spore separation method

Wet Sieving and Decanting Method^[14]

10 gm air-dried rhizospheric soil sample was taken in a conical flask and dissolved in 100 ml distilled water. The solution was stirred well and allowed to settle down for 15-20 minutes. This suspension decanted through 300 μ m, 125 μ m, 75 μ m, 53 μ m pore size sieves consequently. The entire residue was collected in 35 μ m pore size sieve. Then the residue dissolved in distilled water and filter through whatman filter paper. This filter paper placed on the petridish and the residue present on the filter paper was taken in a slide mounted it by cover slip and was examined under the microscope.

2.5 Identification of VAM fungi

The arbuscular mycorrhizal fungi were identified by using manuals^[15-18].

2.6 Statistical methods

All the data were taken in ten replicates and the standard error of mean (SEM) value (\pm) was calculated. Each of the data was checked for interpretation whether they were statistically significant or not. The data were analyzed by using the statistical method like, analysis of variance (ANOVA), and critical difference (CD) at 5% level was calculated as shown in table-1.

3. Result and discussion

The roots of *Aloe vera* showed 95.5% colonization of VA mycorrhiza. Percentage (%) of vesicle is more than the percentage of arbuscule. Seasonal variation of mycorrhizal colonization of *Aloe vera* has been done. In the season of spring (February-April) the highest colonization percentage had been found. Air-dried rhizospheric soil sample was analyzed for spore population and density. *Aloe vera* is polysporal, different and large number of spores was found and dominant species is *Glomus*.

Table 1

Serial No.	Parameters	Results
1	Name of the plant	<i>Aloe vera</i>
2	Family	Aloaceae
3	Place of collection	Darjeeling and Burdwan
4	Habitat	Herb
5	Vesicle (%)	78.30 \pm 2.5
6	Arbuscule (%)	28.0 \pm 1.23
7	Mycelium	+
8	Average colonization (%)	95.5% \pm 3.5
9	Spore density (100gm soil)	158 \pm 6.46
10	VAM species	Mainly <i>Glomus</i>

Table 2: Physiochemical Properties of Rhizospheric Soil of *Aloe vera*

Sr. No	Physiochemical Properties	Observations	
		Darjeeling	Burdwan
1	Temperature	18 $^{\circ}$ C	32 $^{\circ}$ C
2	pH	4.9	7.2
3	Nitrogen (N)	5.18%	0.05%
4	Phosphorus (P)	10.5%	0.15%
5	Potassium (K)	0.015%	0.4%



Fig A: *Aloe vera* plant

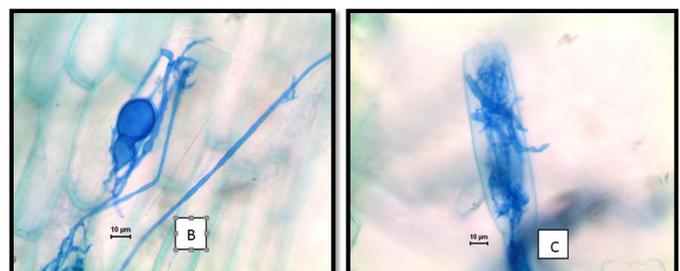


Fig B & C: Vesicle and arbuscule of *Aloe vera*

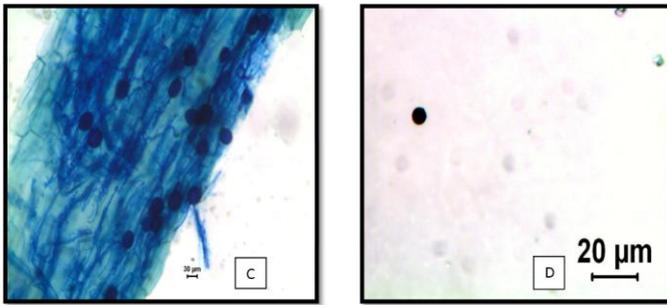


Fig C and D: Vesicles and Spore of *Glomus mossae* of *Aloe vera*

4. Conclusion

In this study *Aloe vera* plants were collected from both the areas of hill and plane land. In the burdwan district, roots of *A. vera* showed 98% VAM colonization. On the other hand the plant collected from the Darjeeling district showed 93% of root colonization of vesicular-arbuscular mycorrhiza. Seasonal variations had been done. From that in the month of February and March it showed highest percentage of colonization. Vesicle, arbuscule, endospore and rhizospheric soil spore had observed. Use of *Aloe vera* is worldwide accepted and commercially very important medicinal herbal plant. Hence it is proved that *Aloe vera* is very suitable host for the production of mass inoculum of vesicular-arbuscular mycorrhiza.

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