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Vesicular Arbuscular Mycorrhizal status of some medicinal plants in the Lateritic soil of South West Bengal (India)

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Abstract

Vesicular Arbuscular Mycorrhizal (VAM) symbiosis is now widely accepted as an essential component of any plant community and play unique role in uptake of nutrient and water particularly in nutrient poor dry soil. Plants with indigenous VAM fungi can mobilize Phosphorus from rock phosphate more efficiently and create a favourable environment for the development of ecosystem process. So, screening of effective VAM species for plant inoculation was thought necessary. The red lateritic soil of South West Bengal is acidic and low in organic carbon, nitrogen and phosphorus. Use of VA mycorrhiza as bio-fertilizers creates favourable soil ecosystem where phosphorus, nitrogen, potassium and other nutrients get mobilized. All of the investigated medicinal plants of South West Bengal were associated with either VAMycorrhizal infection or with Mycorrhizal spore populations. 91% of the medicinal plants of the South West Bengal showed in a range of 10% to 80% of VAM infection.

The red lateritic soil of South West Bengal, India has low pH and low water holding capacity[6]. It is deficient in available phosphate and other nutrients and to a certain extent in nitrogen and organic carbon as well[6,9,21]. The acidity factor, low moisture level tends to immobilize the phosphorus as bound iron and aluminium phosphates and thus reduces its availability[12,13]. With the biofertilizers, not only the input of fertilizer can be lowered but also the loss of fertilizer can be reduced. Mycorrhizae reaches its extensive hyphal system beyond the depletion zone of plant roots and as an obligate symbiont help in absorption and translocation of phosphate and other nutrients[17,23]. Besides nutrients they also provide cross protection from disease and enhance the moisture content through hyphal system in rhizospheric soils[1,3,10]. Vesicular arbuscular mycorrhizae (VAM) act as a bridge between the host and the soil[15,16] and benefit the plant by procuring P and other nutrients from beyond nutrient depletion zone[11,17,22]. VAM are of special significance in low fertility soil[8], where it increases nutrient absorption.

Plant grown under phosphorus deficient soil such as acid lateritic soil, have greater dependence on mycorrhizae[2,7,20]. There is adequate possibility of utilization of VAM fungi in commercial plantation of medicinal plants[4,19]. Propagation of isolated indigenous VAM species on large scale for inoculation to locally grown medicinal plants has enough potential in substituting the high cost phosphate fertilizer with added advantage of being eco-friendly. It has been calculated that 80% of the total phosphate fertilizer requirement could be supplemented by the inoculation of VAM fungi.

A general survey was made on Vesicular Arbuscular Mycorrhizal (VAM) status in common medicinal plants, lateritic zone of West Bengal state, India.

Study Area and Climate: The medicinal plants were collectedfrom the districts of Paschim Medinipur, Bankura, Burdwan, Birbhum and Purulia, West Bengal, India. It is located approximately 21°47' - 24 °35 N latitudes and 88°25'- 86°36' E longitudes. The climate is hot dry subhumid ranging in districts of Purulia and western parts of Burdwan, Bankura, Birbhum and Paschim Medinipur. Maximum temperature of these districts goes upto 45^{0}C(average 43^0 C) and minimum up to 5^{0}C (average 7.5^{0}C) average rainfall is 1300 mm per annum ranging between 1300 mm to 1500 mm. The soil is shallow to deep, radish to yellow red, loamy to clay and imperfectly well drained. Poor capacity of retention of rainwater leads to severe run off and soil loss.

Soil collection: Rhizospheric soil samples were collected from three depths after scraping 1cm top soil i.e. 1-10cm. 11-20cm and 21-30cm. Composite samples were collected in four replicates for each depth. Soil for pot experiment was collected from 0 to 25cm depth from area without vegetation.

Assessment of Vam spore population :

Air dried rhizospheric soil sample (100 g) was taken in 1L beaker, water was added and stirred vigorously for 30 Seconds and allowed to stand for 45 Seconds, the supernatant was passed through sieve sets of 600µm, 300µm, 150µm, 100µm, 50µm, arranged in descending order. Then again water was added and the entire process was repeated three times. The uppermost 600µm mesh contained organic debris, 300µm mesh contained sporocarp with large spores and other three sieves retained the spores of different size. The residues of the sieves retained the spores of different sizes. The residues of the sieves were washed with a water jet and collected in beakers. The content were filtered through filter papers and observed under a stereo microscope (x 30) and the total number counted in 100 g soil[5].

Study of VAM infection :

The entire root system of the sample plants was properly washed to remove adhering soil. The healthy fine roots were cut into I cm pieces leaving the root tips. The root pieces were boiled in 10% KOH in an autoclave at 5 lb/in^2 pressure for 10 minutes; washed with distilled water, acidified with dilute HCl, washed with distilled water and stained with 1% tryphan blue for 2-3 minutes[14]. The

stained root pieces were mounted in lactophenol and observed under compound microscope. Percent infection was calculated as follows:

$$\% \text{ root infection} = \frac{\text{No. of root pieces with VAM infection}}{\text{NO. of root pieces observed}} \text{X } 100$$

VA Mycorrhizal infection or Mycorrzizalspore population was observed in the allmedicinal plants of South West Bengal. Out of 36 medicinal plants 3 plants did not show any Mycorrhizal infection but on the contrary should high VAM spore population. Studying different medicinal plants in lateritic soil the presence of VAM infection was predictable in lateritic soil. Most of the infection was within a range of 20% to 60% with one showing 10% and one 80% VAM infection. Out of 36 medicinal plants 33 plants did show Mycorrhizal infection. Plant grown under phosphorus deficient soil such as acid lateritic soil, have greater dependence on mycorrhizae[2,7,20]. There is adequate possibility of utilization of VAM fungi in commercial plantation of medicinal plants[4,19]. Propagation of isolated indigenous species on large scale for inoculation to locally grown commercialmedicinal plants has enough potential in substituting the high cost phosphate fertilizer with added advantage of being eco-friendly. It has been calculated that 80% of the total phosphate fertilizer requirement could be supplemented by the inoculation of VAM fungi.

Table-1. VA Mycorrhizal status of medicinal plants in the lateritic soil of West Bengal

SL. No.	Plant Name	Family	Spores per 100g soil	Vesicle	Arbuscle	Hypha	VAM Infection %
1	*Aloe vera* (L.) Burm.f.	Liliaceae	361	+	-	+	20%
2	*Smilax indica* Burm.f.	Smilacaceae	122	+	-	+	30%
3	*Physalis peruviana* L.	Solanaceae	305	+	-	+	20%
4	*Saraca asoca* (Roxb.) Willd.	Fabaceae	288	+	-	+	30%
5	*Paederia foetida* L.	Rubiaceae	238	+	-	+	60%
6	*Caesalpinia crista* L.	Fabaceae	253	+	-	+	40%
7	*Artemisia vulgaris* L.	Asteraceae	387	+	-	+	40%
8	*Vitex negundo* L.	Lamiaceae	542	+	-	+	60%
9	*Aerva javanica* (Burm.f.) Schult.	Amaranthaceae	173	+	-	+	20%
10	*Rauvolfia serpentina* (L.) Benth. ex Kurz	Apocynaceae	381	+	-	+	40%
11	*Lobularia intermedia* Webb	Brassicaceae	314	+	-	+	40%
12	*Clerodendrum indicum* (L.) Kuntze	Verbenaceae	113	+	-	+	10%

13	*Sida cardiophylla* (Benth.) F. Muell.	Malvaceae	292	+	-	+	60%
14	*Kalanchoe pinnata* (Lam.)Pers.	Crassulaceae	624	+	-	+	40%
15	*Wrightia antidysenterica* (L.) R.Br.	Apocynaceae	335	+	-	+	60%
16	*Desmodium gangeticum*(L.) DC.	Fabaceae	627	+	-	+	40%
17	*Euphorbia neriifolia* L.	Euphorbiaceae	692	+	-	+	85%
18	*Barleria prionitis* L.	Acanthaceae	620	+	-	+	25%
19	*Withania somnifera* (L.) Dunal	Solanaceae	120	+	-	+	0%
20	*Justicia adhatoda* L. /*Adhatodavasica* Nees	Acanthaceae	409	+	-	+	0%
21	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Acanthaceae	461	+	-	+	40%
22	*Glycosmis pentaphylla* (Retz.) DC.	Rutaceae	178	-	-	+	20%
23	*Azadirachta indica* A. Juss.	Meliaceae	531	-	-	+	35%
24	*Mimosa pudica* L.	Fabaceae	327	+	-	+	50%
25	*Gardenia* J. Ellis	Rubiaceae	374	+	+	+	60%
26	*Centella asiatica* (L.) Urban	Apiaceae	560	-	-	-	0%
27	*Catharanthus roseus* (L.) G. Don	Apocynaceae	482	+	-	+	50%
28	*Helianthus annuus* L.	Asteraceae	631	+	-	+	30%
29	*Ichnocarpus frutescens* (L.) W.T.Aiton	Apocynaceae	208	-	-	+	0%
30	*Abroma augustum* (L.) L.f.	Malvaceae	238	-	+	+	30%
31	*Ocimum serratum* (Schltr.)	Lamiaceae	490	+	-	+	30%
32	*Cheilocostus speciosus* (J.Konig) C. Specht	Costaceae	200	+	-	+	80%
33	*Alstonia scholaris* L. R. Br.	Apocynaceae	274	+	-	+	35%
34	*Scoparia dulcis* L.	Scrophulari-aceae	174	-	-	+	30%
35	*Datura stramonium* L.	Solanaceae	476	+	-	+	50%
36	*Aristolochia indica* L.	Aristolochi-aceae	368	+	-	+	40%

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