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Physico-Chemical Analyses and Status of Arbuscular Mycorrhizal Fungi from Rhizosphere Soils of Solanaceous Vegetables

V. S. Sawant And U. N. Bhale*
Research Laboratory, Dept of Botany, Arts, Science and Commerce College, Naldurg, Tq. Tuljapur, Osmanabad 413602, Maharashtra, India
**Corresponding Author:unbhale2007@rediffmail.com*

Abstract: *Soil characters were studied for the ability of the soil to support Arbuscular Mycorrhizal Fungal (AMF) colonization and spore density. Results of three rhizosphere soil samples of Tomato, Chilli and Brinjal from six different study sites in the region showed variation in soil colour, pH, EC, Organic carbon, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sodium, Zinc, Ferrous, Manganese, Copper and Boron. Root colonization and spore density was correlated with all soil parameters studied except soil colour. In Tomato, correlation between colonization was positive with pH, Electrical Conductivity (EC), Organic carbon, N, P, K, Mg, Fe, Mn, Cu and Br whereas negative with soil Ca, Na and Zn. Spore population showed positive correlation with soil Organic carbon, N, K, Fe and B; and negatively with pH, EC, P, Ca, Mg, Na, Zn, Mn, and Cu. In Chilli root colonization showed positive correlation with all studied parameters except pH, EC, P and Br. Spore population revealed negative correlation with pH, N, Cu and Br and remaining parameters were positively correlated. Root colonization in Brinjal showed negative correlation with only pH and Mg whereas spore availability had negative relation with only pH, K and Mg. AMF inoculum may be in the form of spores or hyphae are the access point of symbiosis between AMF and crop plants. The results of number of spores per 100g of rhizosphere soil studied showed variation according to plant species. In the region highest inoculum density was in brinjal rhizosphere and lowest in chilli rhizosphere. Pearson's correlation analysis showed that spore density was positively correlated with root length colonization in Tomato (r = 0.581), Chilli (r = 0.432) and Brinjal (r = 0.205) but when it was correlated with root colonization there was variation in correlation as Chilli (r = 0.799) and Brinjal (r = 0.900) emerge with strong positive correlation and Tomato (r = - 0.092) with negative correlation.*

Keywords: *Solanaceous vegetables, Physico-chemical parameters, AMF population*

I. Introduction

Marathwada is one of the four regions in Maharashtra state of India. The region comes under Aurangabad Division. It was a part of Nizam's domain, which was known as The Princely State of Hyderabad. This region lies between 17^0 35' N & 20^0 40' N Latitude and 70^0 40' E & 78^0 15' E Longitude. It falls in Deccan Plateau Zone of India with geographical area of 6.5 million hectare occupying 21 % of total area of the Maharashtra. This region is situated at an average height of about 300-650 m. above mean sea level, gradually sloping ranges originating from the Sahyadris in the west and Satpuda ranges in the north. Marathwada is bounded on north by the Vidarbha region, on the east and south east by Andhra Pradesh, on the south by Karnataka and on the west by Western Maharashtra. Marathwada is the region comprising of eight districts i.e. Aurangabad, Jalna, Parbhani, Beed, Osmanabad, Latur, Nanded and Hingoli. The region is rocky and dry with low and uncertain rainfall. The fertility index with respect to Nitrogen and Potash varies in all the districts of Marathwada. Major crops in this region are Sorghum, Cotton, Pigeonpea, Sunflower, Groundnut, Beans and Sugarcane. Region also contributes to fruit crops like Banana, Orange, Grape, Mango, Papaya, Guava, Ber, Lime and vegetable crops like Tomato, Brinjal, Chilli, Cucurbits, Cauliflower, Cabbage, Onion, Garlic, Leafy Vegetables like Spinach, Fenugreek etc. Agriculture is a major source of income for about 70 % population of rural part. Good monsoon results in better farming. Monsoon based farming makes for about six months while remaining months many people shift to Western Maharashtra every year to work as sugarcane cutters. Keeping this above view our study is based on vegetable crops i.e. Tomato, Brinjal, Chilli were selected.

The botanical family Solanaceae is distributed in warmer region of the world [1]. It was described six genera *Solanum, Physalis, Withania, Lycium, Datura and Hyoscyamus* from Bombay Presidency [2]. He described *Solanum tuberosum, Solanum melongena, Nicotiana tabacum, Capsicum annuum, Var. acuminata, albreviata, grossa* and *longum* under cultivated plants. It was described 20 genera and 101 species of family Solanaceae from China [3]. Potato (*Solanum tuberosum* L.), Brinjal (*Solanum melongena* L.), Tomato

(*Lycopersicum esculentum* Mill.) and Chilli (*Capsicum annuum* L.) are some of the important vegetable crops consumed every day.

Brinjal (eggplant) can be successfully grown in very dry areas under rain-fed conditions or with minimum irrigation facilities. Tender delicious fruits are popular as vegetable which has quite high nutritive value and contains an alkaloid called "solanine". Brinjal is good source of potassium and other essential nutrients. Tomato is one of the most consumed vegetable in the world and used for healthy and well-balanced diet. Fruits are consumed fresh in salads or cooked in sauces and can be processed into purées, juices and ketchup. Chilli (Red pepper) occupies an important place in Indian diet. It is grown for vegetables, spices, condiments, sauces, pickles and for making beverages and medicines. The above vegetables are important for human diet therefore for their high yield and nutritive value these are selected to study with respect to arbuscular mycorrhizal fungi.

The word mycorrhiza is a combination of root and fungus found in many plants. Mycorrhiza is a type of endophytic, biotrophic and mutualistic symbiosis prevalent in cultivated as well as wild ecosystems. Plants show ectotrophic, endotrophic and ectendotrophic mycorrhizae [4]. Arbuscular mycorrhizal fungi by virtue of their symbiotic associations with roots are the most significant microbes in agriculture ecosystem which enhance the growth of entire plant and often control certain plant pathogens [5]. These fungi are beneficial to plants as extraradical hyphae explore more amount of soil than plant roots. Hyphae enhance uptake of available soil phosphorus and non-labile minerals essential for plant growth. In return, plants provide photosynthetically-fixed carbohydrates for growth of the fungus. Mycorrhizal fungi improve soil quality by secreting some extracellular glycoprotein called Glomalin. Glomalin produced by AMF moves into soil where it attaches to minerals and organic matter and leads to build up and stabilization of soil aggregates [6,7]. Increased aggregate stability leads to better soil structure which in turn leads to improved plant vigour.

In India, the positive effect of AM fungi in crop plants has been reported from Uttar Pradesh [8], Karnataka [9], West Bengal and Assam [10], Maharashtra [11,12,13,14],Tamilnadu [15], Goa [16] and Delhi [17].

II. Materials And Methods

II.1. Physico-Chemical Characters of Soil

A part of composite soil collected from field was used for physicochemical characterization. Soil was spread out on a tray for air drying. It was sieved over a 2 mm sieve and used for characterization. Soil analysis was done for colour, pH, Electrical Conductivity, Organic carbon %, and major and minor nutrients [Nirogen (kg / hector), Phosphrous (kg / hector), Potassium (kg / hector), Calcium (meq.), Magnesium (meq.), Sodium (meq.), Zinc (ppm), Ferrous (ppm), Mangenese (ppm), Copper (ppm) and Boron (ppm)]. pH of the soil was measured potentiometrically in a 1:5 soil – water suspension by pH meter. Electrical Conductivity (dS/m) which provides concentration of soluble salts in the soil was measured in 1:5 soil-water suspensions by conductivity meter. Organic Carbon was evaluated [18] method by oxidizing organic carbon with potassium dichromate and sulphuric acid. Available Nitrogen was assessed by alkaline permanganate method by using Kjeldhal tube [19]. Available Phosphorus in soil was determined by Olsens method by using spectrophotometer [20,21]. Water soluble and exchangeable Potassium was calculated by Ammonium acetate method [22] using Flame photometer.Calcium and Magnesium cations were estimated by EDTA titration [23]. Analysis of Ferrous, Mangenese, Copper and Zinc were done by acid digestion of soil [24]. All the three solanaceous plants showed arbuscular, vesicular and hyphal colonization and intraradical and extraradical AMF spore as well in variable amount [25].

II.2. Isolation and Quantification of AMF Spores

Sample collection

Polythene bags of field collected rhizospheric soil of Tomato, Brinjal and Chilli were brought to laboratory. Soil was dried at room temperature for 48 hours. These soil samples were mixed to form a composite soil sample of every plant species from every site. These soil samples were store at 4^0 C until processing. A part of composite soil samples was used for isolation and quantification of AM fungal spores. Spore density and spore diversity was studied from every sample collected of Tomato, Chilli and Brinjal. Glomalean fungal spores were isolated from soil by using wet sieving and decanting method [26].

Spore isolation

Hundred grams of field collected and dried composite rhizosphere soil was suspended 1000 mL of tap water in glass beakers. Soil macroaggregates were crushed with glass rod. Suspension was left undisturbed for 10 minutes to allow the heavier soil particles to settle down. After 10 min soil suspension was passed through the stack of sieves in a descending order having mesh size 355 µm, 210 µm, 150 µm, 125 µm, 63 µm and 25 µm. The procedure was repeated to recover maximum spores from soil. The remains on each of the sieves were

washed. The sieving on each mesh was collected into separate small beakers. Sieving was then filtered using graduated Whatman filter paper No 1. Filter paper having spores was placed in a petri dish and observed under stereozoom microscope. Spores or sporocarps were collected on a small triangular piece of filter paper by using blunt-tipped needle.

Spore quantification

Five replicates from composite soil of each species collected from field were subjected for spore density quantification. Isolated spores from 100 g of soil were recorded. These collected spores were separated according to distinct morphological types. 2-5 spores of same morphotypes were mounted on a clean glass slide with a drop of PVLG. PVLG was allowed to set for 2 -5 minutes to become more viscous. A clean cover slip was placed on drop of PVLG and entire spores were observed for morphological study. Later on spores were crushed by applying light to moderate pressure on the cover slip with the tip of a needle. Different wall layers were observed in these crushed spores.

III. Statistical Analysis

The data collected from the experiment were analyzed statistically [27].The corelation between root length colonization percentage and spore density in rhizosphere soil was calculated [29] and denoted by Pearson correlation coefficient 'r'.

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i-1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

III. Results And Discussion

III.1. Physico-Chemical Characters of Soil

Plant health is linked with soil health. Proper management of the soil by conserving and enhancing the soil biota improve crop yields and quality.

During investigation, soil studied from different sites was alkaline in nature with pH ranging from 7.17 to 8.78. Phosphorus which is important factor for AMF development was not deficient at any site in any rhizosphere but in some places it was in excess amount might be it was because of addition of organic fertilizers in crop fields. Phosphorus in the soil was measured between 33.84 to 76.99 kg / hector. EC responsible for movement of cataions and anaions from soil to root was sufficient and ranging from 0.16 to 0.5 dS/m.

Soil characters were studied for the ability of the soil to support AM colonization and spore density. Correlation ranged between +1 to -1 showing positive and negative relation. Results of eighteen rhizosphere soil samples of Tomato, Chilli and Brinjal from six different study sites in the region analysed for nutrient availibiality are described here (Table 1,2 & 3).

In Tomato, Pearson correlation studied between AMF colonization and nutrient availibility in the rhizosphere soil showed positive relation within root colonization and pH, Electrical Conductivity (EC) , Organic carbon, N, P, K, Mg, Fe, Mn, Cu and B whereas negative correlation with soil Ca, (-0.148), Na (-0.361) and Zn (-0.361). Spore population revealed weak positive correlation with soil Organic carbon (0.139), N (0.065), K (0.040), Fe (0.486) and Boron (0.139) and negative correlation with pH, EC, P, Ca, Mg, Na, Zn, Mn, and Cu.

Root colonization from different study sites in chilli plant showed positive correlation with all studied parameters except pH (- 0.714), Elec. Conductivity (- 0.142), P (- 0.412) and B (- 0.875). Spore population revealed negative correlation with pH (- 0.652), N (- 0.549) Cu (- 0.379) and B (- 0.888) and remaining parameters were positively correlated.

Root colonization percentage in Brinjal plant in the region showed negative correlation with soil pH (- 0.645) and Mg (- 0.542) in natural field conditions, out of the remaining parameters studied strong positive correlation was with EC (0.811), N (0.74) and B (0.753). Spore availability in the rhizosphere had negative relation with pH (- 0.605), K (- 0.117) and Mg (- 0.263) except remaining all parameters.

Table 1. Physico-chemical analysis of Tomato rhizospheric soil collected from different study sites.

Sr. No	Parameters of Tomato soil	Osmana bad	Latur	Beed	Parbhani	Jalna	Auranga bad	Root Colonization (r)	Spore Density (r)
1	Colour	Black	Black	White	Brownish Red	Black	Brownish Red	-	-
2	pH	7.31	7.17	7.29	7.37	7.84	7.20	0.436	-0.077
3	EC (dS/m)	0.28	0.18	0.45	0.35	0.50	0.21	0.324	-0.214
4	Organic carbon (%)	0.52	0.74	0.81	0.62	0.54	0.39	0.498	0.139
5	Nirogen (kg/ha)	205.84	203.84	172.48	213.24	313.06	188.04	0.500	0.065
6	Phosphrous (kg/ha)	51.32	52.47	51.32	45.19	46.34	46.73	0.218	-0.441
7	Potassium (kg/ha)	616	612	560	616	784	504	0.748	0.040
8	Calcium (meq/L)	92.75	90.25	105.25	80.25	94.25	107.75	-0.148	-0.693
9	Magnesium (meq/L)	26.17	27.62	33.44	16.78	31.44	28.11	0.543	-0.181
10	Sodium (meq/L)	8.36	8.80	7.71	9.81	12.75	10.97	-0.361	-0.725
11	Zinc (ppm)	1.78	0.78	0.67	1.22	0.91	0.41	-0.361	-0.725
12	Ferrous (ppm)	0.98	2.61	3.40	0.92	3.24	2.24	0.503	0.486
13	Mangenese (ppm)	1.22	3.26	4.34	1.01	3.37	3.78	0.436	-0.077
14	Copper (ppm)	0.84	0.61	0.68	0.54	0.52	0.70	0.324	-0.214
15	Boron (ppm)	1.52	1.26	1.11	1.85	1.26	1.05	0.498	0.139

Table 2. Physico-chemical analysis of Chilli rhizospheric soil collected from different study sites.

Sr. No	Parameters of Chilli soil	Osmanabad	Latur	Beed	Parbhani	Jalna	Aurangabad	Root Colonization (r)	Spore Density (r)
1	Colour	Black	Black	White	Brownish Red	Black	Brownish Red	-	-
2	pH	8.30	8.10	7.41	8.03	8.78	7.90	-0.714	-0.652
3	EC (dS/m)	0.20	0.37	0.26	0.16	0.40	0.29	-0.142	0.094
4	Organic carbon (%)	0.58	0.70	0.29	0.44	0.48	0.49	0.136	0.255
5	Nirogen (kg/ha)	166.20	153.66	172.48	156.8	197.56	119.16	-0.412	-0.549
6	Phosphrous (kg/ha)	50.17	76.99	76.22	50.56	49.79	52.47	0.738	0.814
7	Potassium (kg/ha)	280	952	560	224	336	672	0.623	0.860
8	Calcium (meq/L)	43.5	42.75	42.00	39.00	34.75	30.00	0.520	0.275
9	Magnesium (meq/L)	6.74	56.60	33.22	14.88	19.10	11.58	0.484	0.759
10	Sodium (meq/L)	16.73	15.54	19.02	17.5	15.19	16.95	0.425	0.205
11	Zinc (ppm)	1.41	1.41	1.36	0.96	0.97	0.63	0.571	0.289
12	Ferrous (ppm)	1.30	1.42	1.89	1.15	1.44	1.83	0.417	0.331
13	Mangenese (ppm)	0.35	0.37	0.63	0.26	0.34	0.33	0.569	0.321
14	Copper (ppm)	14.47	8.70	13.76	10.24	10.95	10.42	0.226	-0.379
15	Boran (ppm)	1.11	0.88	0.82	1.05	1.41	0.94	-0.875	-0.888

Table 3. Physico-chemical analysis of Brinjal rhizospheric soil collected from different study sites.

Sr. No	Parameters of Brinjal soil	Osmana bad	Latur	Beed	Parbhani	Beed	Jalna	Auran gabad	Root Colonization (r)	Spore Density (r)
1	Colour	Black	Black	White	Brownish Red	Black	Brownish Red	Black	-	-
2	pH	7.41	7.52	8.13	7.90	8.13	8.10	8.21	-0.645	-0.605
3	EC (dS/m)	0.31	0.43	0.41	0.29	0.41	0.35	0.19	0.811	0.578
4	Organic carbon (%)	0.51	0.72	0.37	0.40	0.37	0.43	0.44	0.289	0.053
5	Nirogen (kg/ha)	225.52	189.93	232.57	182.45	232.57	248.16	145.12	0.740	0.567
6	Phosphrous (kg/ha)	41.47	37.12	60.29	47.89	60.29	33.84	36.35	0.360	0.558
7	Potassium (kg/ha)	364	471	312	391	312	452	354	0.121	-0.117
8	Calcium (meq/L)	61.12	73.54	78.36	62.37	78.36	48.13	55.64	0.501	0.510
9	Magnesium (meq/L)	12.11	16.32	17.09	23.59	17.09	16.08	19.26	-0.542	-0.263
10	Sodium (meq/L)	13.13	14.26	12.58	9.29	12.58	10.61	10.46	0.648	0.388
11	Zinc (ppm)	0.97	1.03	2.11	1.73	2.11	0.99	0.80	0.346	0.539
12	Ferrous (ppm)	2.86	2.47	2.98	3.64	2.98	2.53	1.89	0.509	0.787
13	Mangenese (ppm)	1.81	3.47	3.11	2.77	3.11	2.11	1.82	0.430	0.368
14	Copper (ppm)	0.59	1.76	5.07	0.78	5.07	3.50	0.61	0.359	0.168
15	Boron (ppm)	1.26	0.94	1.10	1.20	1.10	.81	0.63	0.753	0.962

III.2.Isolation and Quantification of AMF Spores

The results of isolation and quantification of AMF spores in Tomato (*Lycopersicum esculentum* Mill.) Chilli (*Capsicum annuum* L.) and Brinjal (*Solanum melongena* L.) rhizospheric soil collected from different fields of Marathwada region are presented in table 4 and fig. 1.

Hundred gram of composite rhizospheric soil from each collected plant which were subjected to isolation and quantification of AMF spores showed variation in spore density. Rhizosporic soil of each species studied in the investigation showed hyphal fragments, azygospores, chlamydospores and sporocarps as AM fungi propagules (Table 6 and Fig. 3).

Tomato: In Tomato, minimum spore density was found at Osmanabad (182.8 spores per 100g of dry soil) while maximum at Beed (596.4). Latur (482.2), Aurangabad (349.2), Jalna (335.4) and Parbhani (248.2) were observed inbetween Osmanabad and Beed sites.

Chilli: In Chilli, maximum spore density was observed at Latur (488.2 spores per 100g of dry soil) while minimum at Jalna (72.4). Beed (347.8), Aurangabad (316.6), Parbhani (236.2) and Osmanabad (176.6) were observed in between Latur and Jalna.

Brinjal: In Brinjal, rhizospheric soil of Osmanabad showed highest number of spores (682.2) which was followed by Beed (602.0), Parbhani (578.4), Latur (485.8), Jalna (363.6) and Aurangabad (96.4). Within the species average spore density was maximum in Brinjal collected from different sites (468.1), medium in Tomato (365.7) and minimum in Chilli (272.8), while studying average spore density within the study sites plants from Beed (515.4) showed maximum and Aurangabad (254.07) showed minimum density. Average spore density in Latur (485.4), Parbhani (354.27), Osmanabad (347.2) and Jalna (257.13) ranged in between Beed and Aurangabad.

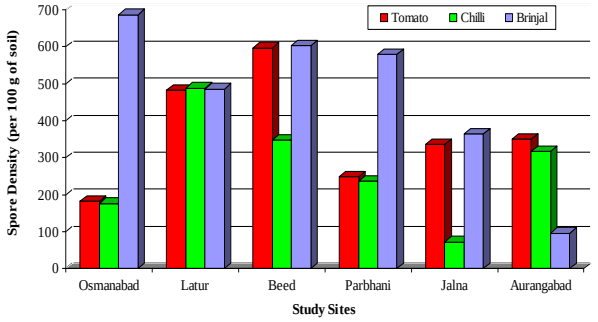
Root length colonization depends on inoculum in the soil, AMF spores are primary inoculum used for better plant growth. There is positive correlation between root length colonization percentage with spores density in the rhizosphere soil in Tomato (r = 0.581), Chilli (r = 0.432) and Brinjal (r = 0.205). When Pearson correlation was studied between root colonization percentage with spores density in the rhizosphere soil, it showed strong positive correlation in Chilli (r = 0.799) and Brinjal (r = 0.899) while negative correlation in Tomato (r = -0.092). In solanaceous vegetable crops studied, maximum spore density (682.2 spores per 100 g of soil) was found in Brinjal at Osmanabad and minimum spore density was also observed in Brinjal (96.4) at Aurangabad.

Table 4. Quantification of Arbuscular Mycorrhizal Fungal spores in rhizospheric soil of Tomato, Chilli and Brinjal collected from different study sites.

Sr. No.	Study Site	Spore density (Number of AMF spores in 100 g dry soil)			Average for site
		Tomato (n*= 5)	Chilli (n*= 5)	Brinjal (n*= 5)	
1	Osmanabad	182.8	176.6	682.2	347.2
2	Latur	482.2	488.2	485.8	485.4
3	Beed	596.4	347.8	602.0	515.4
4	Parbhani	248.2	236.2	578.4	354.3
5	Jalna	335.4	072.4	363.6	257.1
6	Aurangabad	349.2	316.6	096.4	254.1
	Average for species	365.7	272.8	468.1	-
	S. E.	61.98	59.08	86.67	-
	C.D.@ 5%	159.29	151.82	222.73	-

(Values represent average of five replicates, n* = number of rhizospheric soil studied from the field)

Figure 1. Quantification of Arbuscular Mycorrhizal Fungal spores in rhizospheric soil of Tomato, Chilli and Brinjal.



All the sites had adequate mycorrhizal inoculum to support growth. Our findings of spore number are supported [29] who observed 824 spores in Tomato, 716 in Chilli, 479 in Pigeon pea and 589 in Soghum while studying occurrence and distribution in agricultural fields of Mysore. It was evaluated arbuscular mycorrhizal fungi from rhizosphere soils of solanaceous crops and observed variation from 26 to 1012 spores / 10 g of soil; maximum number (1012) was from Eruthyampathy site in Brinjal and minimum (26) was from from Chittoor site in Chilli [30]. It was carried out survey of AM fungi from rhizosphere and non-rhizosphere soil of Tomato (*Lycopersicon esculentum* Mill.) from Nashik district of Maharashtra and reported maximum 1580 AM propagules per 100 g of soil (Bharam locality) with minimum 174 AM propagules (Panjarwadi localiy) [31]. In cropped land, *Capsicum annuum* L. showed 170 spores while *Lycopersicon esculentum* Mill showed 167 spores per 20 g of soil, average spore density in fallow land (formerly cultivated land that has been left to natural fallow regrowth for 4 years) (329 ± 14) and undisturbed land (natural Savanna land) (347 ± 21) were significantly higher than that in cropped land (cultivated with field crops since about 30 years) (209 ± 13) [32]. It was observed 26 to 35 spore populations per 10 g of soil in *Capsicum* from different places of Rajasthan and found AMF spore density was not clearly affected by the host *Capsicum* and suggests that biotic factors may be relatively less important than abiotic/edaphic factors for establishing population pattern [33]. It was observed less number of AM spores in *Solanum nigrum* growing on sugar mill effluent polluted soil (52-85) than on non polluted soil (90-120) and concluded that increased levels of micronutrients and heavy metals caused reduction in the AM propagules [34]. It was observed 1230 spores in *Solanum indicum* and 2190 spores in *Physalis alkekengi* of family solanaceae [35]. During the survey of AMF diversity in 46 medicinal plant species of herbs and shrubs growing in Western Ghats of Karnataka [36] observed 202 spores in *Withania somnifera* of family solanaceae while remaining species ranged in 15 to 520 spores per 100 g of soil. It was (add) studied *Hyoscyamus niger* L. of family Solanaceae which showed 9.9 number of spores per 10 g of rhizospheric soil from Kharajoo region of Iran., there was positive correlation between percentage root colonization and spore number with correlation coefficient 0.73 [37]. It found that increased land use intensity was correlated with a decrease in AMF species richness and with a preferential selection of species that colonized roots slowly but formed spores rapidly [38]. It was studied spore density and the frequency of spore types in intensively used agricultural soils of different types, where soil type influenced spore density and displayed a characteristic distribution of spore types [39]. Our results showing variation in number of spores might be the result of interaction between microbes in soil and soil characteristics.AMF spore abundance and species diversity were significantly higher in organic farming systems than in conventional farming system. This study confirms that organic farming increases mycorrhizal inoculum potential [40].It was observed positive correlation (r = 0.99) in three *Solanum* species while found inverse correlation (r = -0.96) perennial grasses [41].

Physico - Chemical properties of Marathwada soil assessed [42] and showed pH (7.0 to 8.5), salinity EC (0.1 to 0.35 dS/m), Organic carbon (– 0.30 to 0.80 %), Ca (- 0.00 to 22.0 %), N(less to medium), P (less to medium), K (medium to more), Zn (0.1 to 3.06 ppm), Fe (0.6 to 16.00 ppm), Mn (1.20 to 27.20) ppm and Cu (0.78 to 4.30 ppm). Colour of the soil in region is white, dark yellow, brown to brownish black which showed resemblance with our results. Results observed during investigation was supported [33] where spore density of AMF had a strong positive correlation with soil pH and organic carbon content and a negative correlation with Olsen's P content of the soil. It was studied relation between soil characters and occurrence of AMF where greater number of AM fungal propagules were found in neutral to slightly alkaline (pH 7 to 8) soil where as alkaline soils (pH higher than 8.0) have not favored mycorrhizal fungi [43]. AMF have the potential to improve physical, chemical and biological quality of soil by increasing 'C' input in soil [44] and formation and maintainanc of soil structure [45]. Organic matter acts as adhesive for binding soil components and improve water infiltration and water holding capacity. Organic carbon or organic matter is the indicator of soil quality and productivity [46].

In turkey the spore densities of AMF had weak and negative correlation with electrical conductivity. CaCO3 percentages (r = 0.644) were significantly positively correlated whereas it was negatively related to the soil organic matter, N, P, K, Ca, Na, Cu and B. Soil Mg, Cu and Zn content had positive correlation with infection rate (colonization) (r = 0.65, 0.732 and 0.686 respectively). But, negative and non significant correlation between infection rates with EC, P and Na contents of soil [47].

IV. Conclusion

Rhizosphere soil is the first home to a number of microorganisms. All the three species studied of family solanaceae showed AMF spores in the rhizospheric soil. Variation in spore number might be the interactive effect of ecological factors such as soil properties, temperature, annual rainfall and agricultural practices. All the sites had adequate mycorrhizal inoculum to support growth. Average Spore density found in Tomato, Brinjal and Chilli was variable. Average for AMF spores, according to site was variable at different sites studied. Our data showed variation in the spore density at dfferent sites of Marathwada it might be due to different soil moisture conditions.

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