



Effect of physicochemical factors in diversity of rhizosphere mycoflora from banana field

Sadhana N Salve, Swati N Gaikwad, SK Rajurkar

Department of Botany, Deogiri College Aurangabad, Maharashtra, India

Abstract

Present studies were carried out at Jalgaon district from July 2016 to Dec. 2016 in two intervals. Soil samples were collected from different location of banana crop field's. Rhizosphere soil mycoflora were isolated by two methods i.e. soil dilution method and soil plate method on PDA and CZA medium. The fungi were identified and characterized with the help of authentic manuals (Barnet H.L. January 1972). Total ten species belongs to seven genera were recorded from different banana fields. The most common mycoflora are *Aspergillus niger*, *Fusarium oxysporum*, *Fusarium monaliforma*, *Aspergillus flavus*, *Cladosporium musa*, *Curvularia lunata*, *Verticillium sp*, *Aspergillus nidulance*, *Alternaria alternata*, *phytophthora sp*. (Figure-2) Fungal diversity of Rhizosphere soil depends on physicochemical factors and growth of crops. The percent contributions of soil mycoflora were analyzed.

Keywords: rhizosphere soil, mycoflora, diversity

Introduction

Soil is an oligotrophic medium for the growth of fungi. Readily available nutrient are not present for long time in a circumscribed. In general the concentration of microbes is very high near to the surface of Rhizosphere. Arbuscular Mycorrhiza fungi, where exudates are extraordinarily important source of organic energy entering the soil. Fungi are heterotrophic organisms, depending on exogenous carbon for growth and different clades of fungi utilize different carbon substrates. Plant root exudates contain simple carbon substrates, including primary metabolites, such as sugars, amino acids, and organic acids, in addition to a diverse array of secondary metabolites that are released into the Rhizosphere and surrounding soil. Similarly physiochemical properties of Rhizosphere soil important factor for the growth of fungi.

Filamentous fungal hyphae interact with soil particles, plant roots and rocks for absorbing nutrients. Soil micro-flora plays an important role in evaluations of soil condition and in stimulating plant growth. Soil fungi are important for water relation, nutrient cycle and diseases of crop plants. The amounts of organic and inorganic material available in the soil have a direct effect on fungal population. Chemical fertilizers and wide range of pesticides shows adverse effect on mycoflora. Soil microflora is also useful to maintain soil fertility and eco-balance in the soil atmosphere. Fungal population and types directly depends on pH, nutrient, Electric conductivity (EC), temperature, moisture of soil. Aim of present study is to isolate and identify the Rhizosphere soil mycoflora of banana field and correlate with physicochemical factors present in soil.

Materials and Methods

Rhizosphere soil samples were collected from different region of Jalgaon District [Maharashtra]. Soil sample of banana crop

fields were collected during July 2016 to Dec.2016 in two intervals. Soil samples were collected from banana field with the help of sterile digger. Rhizosphere soil dugged up to 15 cm to 20 cm depth and amasses in small sterilized polythene bags and brought to laboratory for further investigation. (Cindy D. C. Barillot and Claude-Olivier Sard et.al (2017), (Agritech portal-2013), (Noynul Abedin et. al 2011)^[9].

Isolation of fungi from the soil samples

The Rhizosphere soil fungi were isolated by two methods i.e. Soil dilution method and Soil plate method on two different media i.e. potato dextrose agar (PDA) and Czapeks Dox Agar (CZA).

Soil dilution method

(Selman A. Waksman 1921)^[2], (K. saravana kumar and V.Kaviyaeeasan-2010)^[3] In this method 1 gm of soil sample was diluted in 10 ml of sterilized distilled water to make microbial suspension 10^{-1} to 10^{-5} . Dilution of 10^{-2} to 10^{-5} were used to isolate fungi 1 ml of dilution was taken from each serial dilution sample in triplicate form in petriplate and add approximately 15 ml medium. The petriplate were incubated at 28°C for 72.

Soil plate method

(G. Gaddeyya. et al-2012)^[1] about 0.005 g of soil was scattered on the bottom of sterile petriplate and cooled (40-45°C) agar medium [PDA and CZA] was added, which is then rotated gently to disperse soil particles in the medium. Then petriplate were incubated at $28 \pm 2^{\circ}\text{C}$ for 3 days.

Identification of soil fungi

Fungi were isolated on the basis of their morphological feature and microscopic structures. The fungi were identified with the help of literature. (Hand book of soil fungi-Nagmani - 2006),

(Manual of soil fungi – Joseph C. Gilman - 1998) [5], (The illustration of imperfect fungi - C.J. Barnett 1972). The percent contribution of each isolated fungi was calculated by using following formula (K. Saravanakumar et.al.-2010) [7]

$$\% \text{ contribution} = \frac{\text{total no. of an individual species}}{\text{total no. of CFU of all species}} \times 100$$

CFU - colony forming unit

Physicochemical analysis of Rhizosphere soil

(Relating to both physical and chemical properties). Physical parameters of soil pH, electric conductivity and chemical parameters such as organic carbon, nitrogen; phosphorus, potassium, zinc, Manganese, Iron, Copper were analyzed. (District soil survey and soil testing Office Shahanoormiya Darga, Osmanpura, Aurangabad).

Results and Discussion

Fungal diversity of Rhizosphere soil depends on a number of factors of soil i.e. pH, electric conductivity, organic content and transition elements. Present investigations showed following ranges of physicochemical parameters. PH ranges between 8.04-8.5 and Electric conductivity (EC) from 0.34-2.3. The organic carbon were present in i.e. 0.43 % to 0.78 %, Nitrogen (N) 0.285 to 0.340 N (Kg/ha), Phosphorus (P) 159.67 to 2.71 (Kg/ha), Potassium (K) 1660.28 to 666.44, Copper (Cu) 1.18 to 2.00, Iron (Fe) 0.72 to 1.34, Zinc (Zn) range in between 0.38 to 1.72, Manganese (Mn) range in between 1.46 to 4.98. (Table No. 1). above parameters compared with standards. (Table no. 2).

Percentages of soil components directly affect the fungal population and their diversity in banana fields. During the present study 218 colonies of 10 fungal species were observed. (Table No.3) Their percent contribution, distribution and dominance in each field were different. *Aspergillus niger* was dominating in the field VI of Balad as compared to other fungi because pH -8.04, (EC)- 0.78 ms/cm, (P)- 45.96 Kg/ha, (K)- 1660.28 Kg/ha, (Cu)- 1.56ppm, Fe- 0.78ppm, Zn- 0.98ppm, Mn-1.46ppm and organic carbon-0.69% was suitable for growth.

High percentage of *Fusarium oxysporum* observed in the Field Vth of Hatgaon, distract Jalgaon. Following parameters enhances growth of Fusarium in the field. pH - 8.5, (EC) – 1.47 ms/cm, (P) – 38.71 kg/ha, (K) – 720.6 kg/ha, (Cu) – 1.56 to 1.58 ppm, Fe – 0.44 to 0.78 ppm, Zn – 0.88 to 0.98 ppm, Mn – 1.46 ppm, organic carbon – 0.56 %.

Similarly little fluctuation in the physicochemical properties of field shows considerable change in percentage and distribution of fungal species. *Aspergillus nidulance* and *Aspergillus flavus* found in Ist field and *Curvularia lunata*, *Alternaria alternata* in IInd field of Hatgaon. *Cladosporium musae* (field IV), *Verticillium sp* (field VIII) and *Fusarium monaliforme* (field III) their growth accelerate due to pH – 8.5, EC – 1.55ms/cm, P – 24.43kg/ha, K – 897.74kg/ha, Cu- 1.48ppm, Fe – 0.8ppm, Zn – 0.38, Mn – 1.48, organic carbon – 0.43% (Table 2).

The percent contributions of fungal species in each banana crop field were various that shown in Figure 1. Above observation indicates that variations in the fields occurred due to availability of physiochemical factors present in Rhizosphere soil samples.

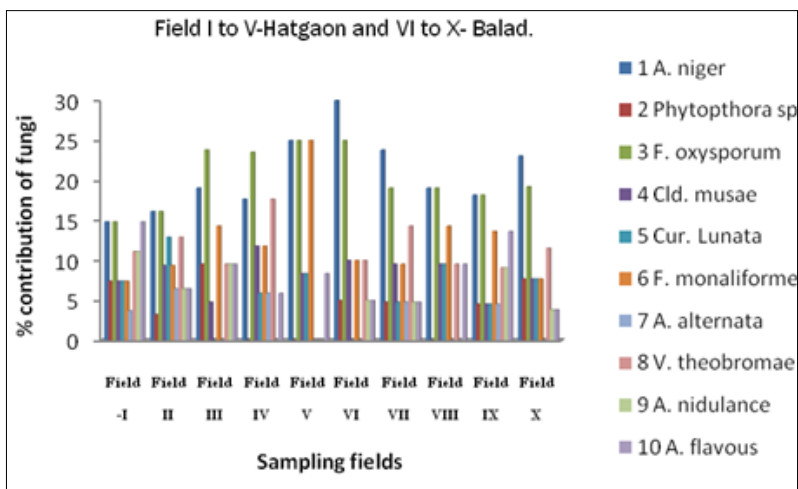


Fig 1: Percent contribution of fungal species in different banana Crop Field at Jalgaon District.



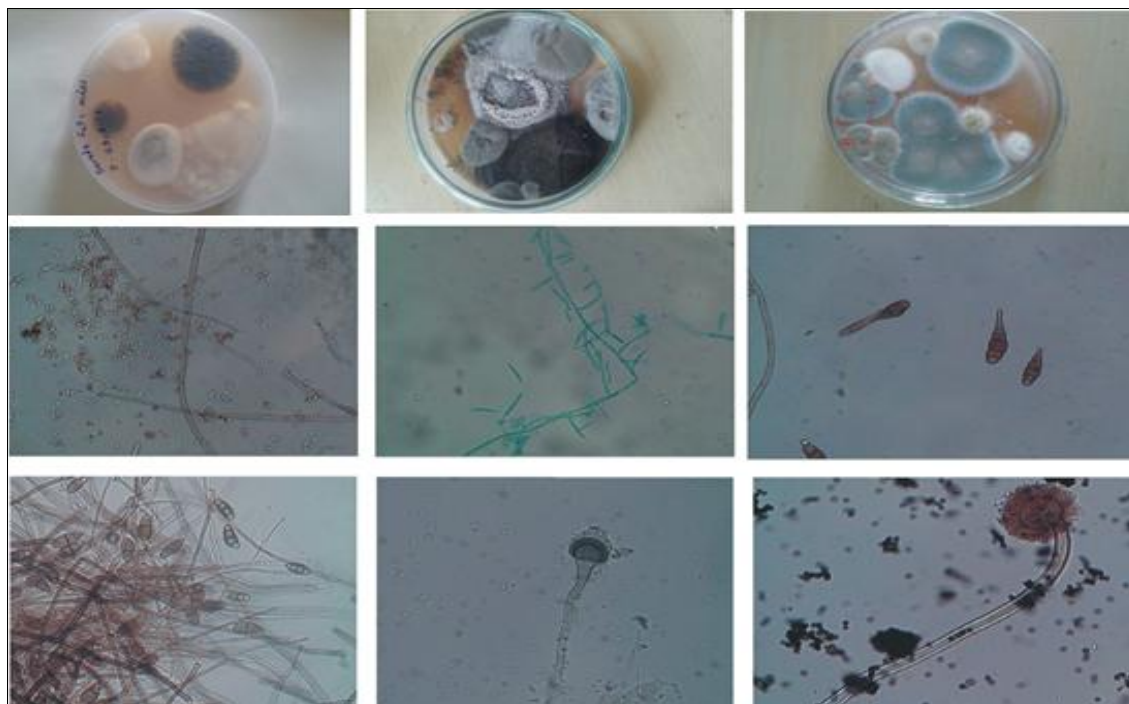


Fig 2: Photo-Plates: Petri plate of sampling sites and fungal species

Table 1: Physicochemical properties of Rhizosphere soil samples collected from Banana crop field.

Sr. No.	Location	Physicochemical parameters										
		pH	E.C. (ms/cm)	N (Kg/ha)	P (Kg/ha)	K(Kg/ha)	Cu (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Organic Carbon (%)	
1	Hatgaon Region											
	Field-I	8.1	2.3	0.290	2.71	1185.01	1.42	1.34	0.64	1.78	0.51	
	Field-II	8.3	0.34	0.295	60.48	666.44	2	1.02	0.56	1.52	0.57	
	Field-III	8.4	0.36	0.306	159.67	1145.93	1.18	1.08	1.72	4.98	0.71	
	Field-IV	8.5	1.55	0.297	24.43	897.74	1.48	0.8	0.38	1.48	0.43	
Field-V	8.5	1.47	0.340	38.71	720.3	1.58	0.44	0.88	1.5	0.56		
2	Balad Region											
	Field-VI	8.4	0.78	0.305	45.96	1660.28	1.56	0.78	0.98	1.46	0.69	
	Field-VII	8.3	0.54	0.340	36.29	1010.75	1.26	0.82	0.58	1.94	0.58	
	Field-VIII	8.4	1.78	0.285	106.44	1392.02	1.48	0.72	0.9	2.2	0.78	
	Field-IX	8.3	0.4	0.320	43.55	947.38	1.52	0.72	0.8	1.98	0.64	
Field-X	8.3	0.65	0.290	41.13	1308.58	1.22	0.86	0.52	2.26	0.51		

EC-Electric conductivity, N-Nitrogen, P-Phosphorus, K-Potassium, Cu-Copper, Zn-Zinc, Mn-Manganese

Table 2: Standard range of physicochemical properties of soil.

pH	Highly acidic	Very acidic	Medium acidic	Slightly acidic	Neutral	Slightly basic	Medium basic
	0 - 4.49	4.50 - 5.19	5.20 - 5.99	6 - 6.9	6.50 - 6.99	7 - 7.49	7.50 - 8.29
Sr. No.	Chemical properties	Very few	Few	Medium	Moderate	Much	More
1	OC	0 - 0.19	0.20 - 0.39	0.40 - 0.59	0.60 - 0.79	0.80 - 0.99	1 - 99.99
2	N	0 - 139.99	140 - 279.99	280 - 419.99	420 - 559.99	560 - 699.99	700 - 999.99
3	P	0 - 6.9	7 - 13.99	14 - 20.99	21 - 27.99	28 - 34.99	35 - 999.99
4	K	0 - 99.99	100 - 149	150 - 199.99	200 - 249.99	250 - 299.99	300 - 999.99
5	Fe	-	0 - 4.50	4.50 - 4.50	4.50 - 99.99		
6	Cu	-	0 - 0.20	0.20 - 0.20	0.20 - 99.99		
7	Mn	-	0 - 1.99	2 - 2	2 - 99.99		
8	Zn	-	0 - 0.59	0.60 - 0.60	0.61 - 99.99		

Table 3: Frequency of mycoflora in different location of banana crop fields

Sr.No	Location of banana crop field	Average No. of total colonies	Average number of individual colonies										
			A. nig.	Phy. SP	F. oxy	Cla musa	Cu lunata	F. mona	A. alter	Vert. theo	A.nidu	A.flavas	
1	Hatgaon Region												
	Field I	27	4	2	4	2	2	2	1	3	3	4	
	Field II	31	5	1	5	3	4	3	2	4	2	2	
	Field III	21	4	2	5	1	nil	3	nil	2	2	2	

	Field IV	17	3	nil	4	2	1	2	1	3	nil	1
	Field V	12	3	nil	3	1	1	3	nil	nil	nil	1
2	Balad Region											
	Field VI	20	6	1	5	2	nil	2	nil	2	1	1
	Field VII	21	5	1	4	2	1	2	1	3	1	1
	Field VIII	21	5	nil	5	2	2	3	nil	2	nil	2
	Field IX	22	4	1	4	1	1	3	1	2	2	3
	Field X	26	6	2	5	2	2	2	nil	3	1	3
	Total	218	45	10	44	18	14	25	6	24	12	20
	% Contribution		20.64	4.58	20.18	8.25	6.42	11.46	2.75	11	5.5	9.17

A.nig - *Aspergillus niger*, *Phy*- *Phytophthora SP*, *F. oxy*- *Fusarium oxysporum*, *Clad. musa* - *Cladosporium musae*, *Cur. lunata* - *Curvularia lunata*, *F. mona.* - *Fusarium monaliforma*, *A. alter* - *Alternaria alternate*, *Ver.theo.*-*Verticillium theobromae*, *A. nidu.*, -*Aspergillus nidulance*, *A.flavas*—*Aspergillus flavas*

Conclusion

Total ten fields were studied for screening and detection of fungal diversity. The result obtained clearly indicate high occurrence of *Aspergillus niger*, *Fusarium oxysporum*, *Fusarium monaliforme*, *Verticillium sp.*, *Aspergillus flavas* in all banana field due to high percentage of potassium and phosphate, medium range of iron and Nitrogen and moderate range of Zn,Cu,Mn and alkaline pH.

This enhances the growth of above fungi. Percentage and Dominance of *curvularia lunata*, *Cladosporium musae*, *Alternaria alternata*, *Aspergillus nidulance*, *Phytophthora sp* were less as compare to above fungi. Among the isolates *Aspergillus niger*, *Fusarium monaliforme* and *Fusarium oxysporum* were dominant in all banana fields. *Fusarium oxysporum*, *Fusarium monaliforme* and *Aspergillus niger* causes wilt of plants, fruit rot disease, root rot disease respectively. The frequency of Rhizosphere mycoflora in banana fields was found to be regulated by many physicochemical factor of soil.

Acknowledgement

Financial assistance was supported by UGC under Rajiv Gandhi National Research fellowship. We are thankful to District soil survey and soil testing Office Shahanoormiya Darga, Osmanpura, and Deogiri College Aurangabad for providing laboratory facility.

References

- Gaddeyya G, *et al.* Advances in applied science research. 2012; 3(4):2020-2026.
- Selman A, Waksman A. method for counting the number of fungi in the soil. 1921; 2:339-340.
- Saravanakumar K, Kaviyaasan V. seasonal distribution of soil fungi and chemical proportion of montatne wet temperate forest type of Tamilnadu Journal of plant Science, 2010; 4(6).
- Hand book of soil fungi- Nagmani, 2006.
- Manual of soil fungi Joseph C. Gilman, 1998.
- The illustration of imperfect fungi-C.J. Barnet
- Saravanakumar K, *et al.* African journal of plant science. 2010; 4(6):191-196.
- Ran Erel, Annette Bérard, Line Capowiez, Claude Doussan, Didier Arnal, Gérard Souche, André Gavaland Christian Fritz. Eric J. W. Visser & Silvio Salvi & Chantal Le Marié & Andreas Hund & Philippe Hinsinger (Plant Soil, Soil type determines how root and

Rhizosphere traits relate to phosphorus acquisition in field grown maize genotypes, 2017.

- Noynul Abedin, Nuzhat Ara M, Sohrab Ali M. Khalequzzaman Journal of Bio- Science, Nematode diversity in banana Rhizosphere from northern districts of Bangladesh 2011, 19.