© 2023, Centre for Advanced Research in Agricultural Sciences
Research Journal of Agricultural Sciences
Volume 14; Issue 05 (Sep-Oct 2023); pp 1505–1509

Open Access

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

Fungal Diversity in Rhizosphere Soil of Sugarcane Fields at Dhule District, Maharashtra, India

Kavita Patil[1] and K. N. Borse*[2]

[1-2] P. G. Department of Botany, SSVPS's L. K. Dr. P. R. Ghogrey Science College, Deopur, Dhule - 424 005, Maharashtra, India

Abstract

Rhizosphere soil samples were collected from six sugarcane fields of Sakri and Shindkheda tahasils of Dhule district, in three different seasons summer, rainy and winter. Rhizosphere soil fungi were isolated by two methods, Soil dilution method and soil plate method on potato dextrose agar and Czapeks Dox Agar. Soil chemical properties including soil pH, Soil temperature, Soil moisture, Soil alkalinity, Available N, P, K, Ca, Mg and S were also analyzed. Highest number of fungal species were recorded in field no.1 Rainy season of Sakri tahasil, Minimum were recorded in fields 3 (Winter season) of Sakri tahasil and lowest were recorded in fields 6 (Summer season) of Shindkheda tahasil. The rhizosphere fungal population of each field was correlated with physicochemical properties of soil of each field. The most dominated species in all fields were *Alternaria*, *Aspergillus* and *Rhizopus*. *Penicillium* is predominant in winter, while *Aspergillus* more frequently in summer season acidic pH, optimum moisture content, soil silt and clay texture are most favourable parameters for growth of fungi.

***Key words*:** Rhizosphere fungi, Physicochemical properties of soil, Sugarcane field, Dhule

In soil plant micro-organism system, soil is act as store house of nutrients and energy for living organism. Soil microorganism are also important vital component of soil ecosystem. Especially, rhizospheric microorganism are the crucial components of sustainable agricultural ecosystem. Rhizopheric soil fungi are also one of the important parts of them. Fungi are widely distributed in the soil ecosystem. Soil fungal communities play important role in biogeochemical cycle, decomposition of organic matter, plant growth and control of disease [1]. Among all soil microorganism, fungi play an important role in soil ecosystem in decomposing plant residue, while other fungi antagonize plant pathogens [2]. Sugarcane (*Saccharum officinarum* L.) is one of the most important cash crops in India.

In Maharashtra, Dhule district 1 to 2% of sugarcane crop production was found in Sakri, Shindkheda, Shirpur tahasil and below 0.75% in Dhule tahasil. Hence, the present investigation was focus on fungal diversity in rhizosphere soil of sugarcane crop field from Sakri and Shirpur tahasils of Dhule district.

MATERIALS AND METHODS

Collection of soil samples

Rhizosphere soil samples were collected from 6 different fields of Sakri and Shindkheda tahasils of Dhule district in Maharashtra s, during the period (2020-2021) in three intervals. In each fields soil samples were collected from the surface are reaching about 10-15 cm depth and near the rhizosphere region of plants. The collected soil samples were brought to the laboratory in sterile polythene bags for further analysis. Season and site of sample collection shown in (Table 1).

Table 1 Season and site of sample collection

Field No.	Season	Collection Site	Taluka
Field 1	Summer	Bhondgaon	Sakri
Field 2	Summer	Newade	Shindkheda
Field 3	Rainy	Dhadane	Sakri
Field 4	Rainy	Dabhashi	Shindkheda
Field 5	Winter	Vasmar	Sakri
Field 6	Winter	Varshi	Shindkheda

Isolation of fungi from soil samples

The rhizosphere soil fungi were isolated by two methods i.e., soil dilution method or soil plate method on two different media i.e., Potato Dextrose Agar (PDA) and Czapeks Dox Agar (CZA).

Soil dilution method

Soil dilution procedure was performed by using method of Selman and Waksman [3], Saravanakumar and Kaviyaeasan [4]. In this method 1gm of soil samples was diluted in 10ml of sterilized distilled water to make microbial suspension 10^{-3}

Received: 12 Aug 2023; Revised accepted: 02 Oct 2023; Published online: 07 Oct 2023

Correspondence to: K. N. Borse, P. G. Department of Botany, SSVPS's L. K. Dr. P. R. Ghogrey Science College, Deopur, Dhule - 424 005, Maharashtra, Tel: +91 9423941105; E-mail: kingborse18@gmail.com

Citation: Patil K, Borse KN. 2023. Fungal diversity in rhizosphere soil of sugarcane fields at Dhule district, Maharashtra, India. *Res. Jr. Agril. Sci.* 14(5): 1505-1509.

dilution were used to isolate fungi. 1ml of dilution was taken from each serial dilution sample in triplicate form in Petri plate and add approximately 15ml medium. The Petri plate were incubated at 28 °C for 5 to 7 days.

Soil plate method

Soil plate procedure was performed by using the method of Gaddeyya *et al*. [5]. About 0.005g of soil was scattered on the bottom of sterile Petri plate and cooled (40 °C – 45 °C) agar medium (PDA and CZA) was added which was then rotated gently to disperse soil particles in the medium. The Petri plates were incubated at 28 °C for 5 to 7 days.

Statistical analysis of isolated soil fungi

The number of colonies per plate in 1gm of soil was calculated. The percentage contribution of each isolate was calculated by using standard formula.

Analysis of physicochemical parameters of different sugarcane soil samples

The different soil parameters analyzed by different methods. Such as, pH by pH meter, organic carbon with potassium dichromate, Available Nitrogen by alkaline permanganate method, Available Phosphorus by Olsen's method, Potassium was Ammonium acetate method, Calcium and Magnesium by EDTA titration and Sulphur by colorimetric procedure.

RESULTS AND DISCUSSION

Rhizosphere soil sample were collected from 6 sugarcane fields of Sakri and Shindkheda tahasil of Dhule district in summer, rainy and winter season (2020-2021). Shown in (Table 1) total 18 species were identified with relevant literature; during this investigation total 195 fungal colonies were isolated (Fig 1). The isolated and identified fungal colonies and microscopic structure (Photoplate 1-2). Colony forming is a good estimate of fungal in different ecosystem. Such as the soil and is one of the most common methods used by various researchers. The colony forming unit of soil CFU/gm were shown in (Table 3).

The physicochemical parameters as shown in (Table 2). Fungal diversity of any soil depends upon physicochemical parameters of soil. During analysis of physicochemical parameters of soil in all 6 fields, the pH and moisture content were almost same in field 4 and field 5 but in field 3 shows slight variation in pH and higher moisture content.

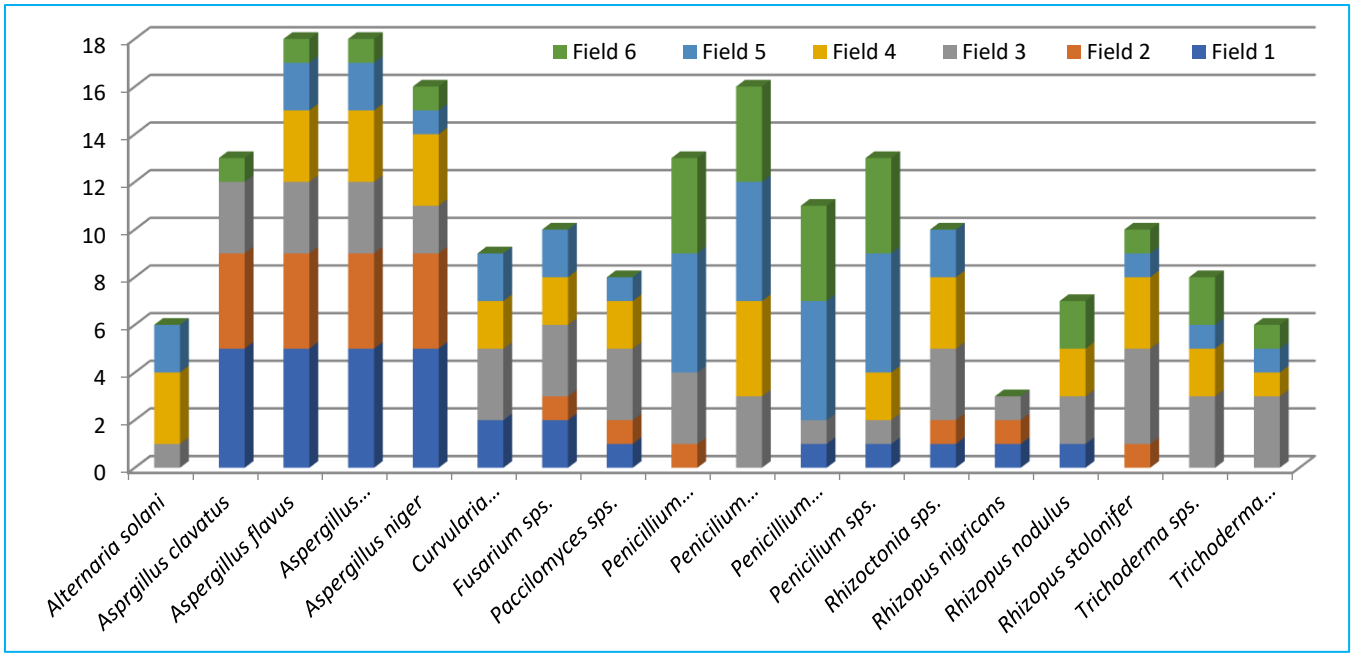

Fig 1 Number of colonies of fungal species in six fields

Table 2 Analysis of soil chemical properties in different fields of Dhule district

Parameters	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
Soil pH	6.1	7.0	4.6	5.0	5.3	6.1
Soil temperature (ºC)	29.10	30.00	25.30	21.11	20.60	28.10
Soil moisture (%)	22.10	20.00	38.02	35.00	34.12	23.00
Soil alkalinity (meq/100g)	0.40	0.53	0.10	0.49	0.14	0.52
Soil organic carbon (%)	0.21	0.51	0.51	0.72	0.42	0.54
Available nitrogen (kg/hec)	210.00	280.00	388.12	312.00	294.00	288.6
Pottasium (kg/h)	189.00	191.00	190.00	161.00	141.00	175.00
Sulphur (ppm)	13.00	12.00	14.00	12.12	10.11	14.1
Magnesium (meq/L)	21.00	23.10	12.13	13.10	17.17	18.18
Phosphorous (kg/h)	18.11	20.10	14.10	14.00	17.16	17.00
Calcium (meq/L)	18.10	39.10	17.40	30.30	15.00	21.10
Soil colour and texture	Brownish red and silt	Brownish sandy	Brownish red and clay	Black and silt	Blackish red and silt	Blackish red and silt

Table 3 Rhizospheric fungal population (X10^{-3}CFU/g soil) of sugarcane crops

Plate No.	Fungal population					
	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
I	31	22	44	36	38	27
II	30	21	46	35	37	26
III	29	23	45	34	36	25
Average	30	22	45	35	37	26
CFU/g of soil	32,258	24,719	63,380	51,470	44,047	32,911

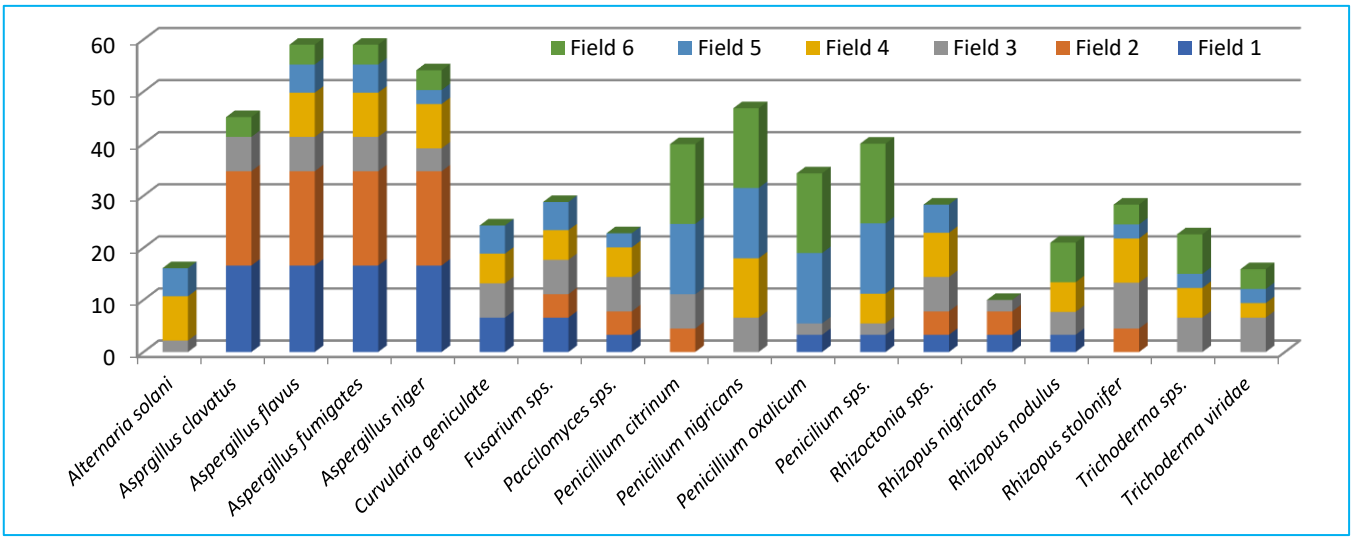

Fig 2 Percentage contribution of fungal isolated

Total number of colonies in field 4 is 35 and field 5 is 37 with slight variation because of almost similar pH 5.0 and 5.3 and moisture content about 35.00% and 34.12% but in field 3. There are 45 colonies were obtained because high moisture content 38.02% and low pH 4.63. Distribution of soil fungi also depend upon soil texture, climate condition [6-7]. So, our result is also similar to above researchers there is direct relationship is observed between soil texture and moisture content in field 3, texture of soil clay types which hold highest moisture content so, in field 3 highest fungal population was observed. Number of different fungal species, fungal colonies and percentage contribution was observed in (Table 4).

The percentage contribution shows variation in different fields. Highest number of fungal colonies found in field 3 (45 colonies and 18 species) followed by field 5 (37 colonies and 15 species), field 4 (35 colonies and 14 species), field 1 (30 colonies and 12 species), field (26 colonies and 12 species) and lowest in field 2 (22 colonies and 10 species).

In the present investigation three genera were dominant. *Aspergillus*, *Penicillium* and *Rhizopus*. *Penicillium* is predominant in winter, while *Aspergillus* occurred more frequently in the summer. *Aspergillus* are not only dominant but also common in all soil samples. This observation in the present study were similar to [8-11].

Table 4 Total number of colonies and percentage contribution of fungi recorded from rhizosphere of sugarcane from different fields of Dhule district

Name of fungal species	Field 1		Field 2		Field 3		Field 4		Field 5		Field 6	
	Sakri Tahasil in summer season		Shindkheda Tahasil in summer season		Sakri Tahasil in rainy season		Shindkheda Tahasil, rainy season		Sakri Tahasil, winter season		Shindkheda Tahasil, winter season	
	No. of colonies	% Contribution	No. of colonies	% Contribution	No. of colonies	% Contribution	No. of colonies	% Contribution	No. of colonies	% Contribution	No. of colonies	% Contribution
Alternaria solani	0	0	0	0	1	2.2	3	8.5	2	5.4	0	0
Asprgillus clavatus	5	16.6	4	18.1	3	6.6	0	0	0	0	1	3.8
Aspergillus flavus	5	16.6	4	18.1	3	6.6	3	8.5	2	5.4	1	3.8
Aspergillus fumigates	5	16.6	4	18.1	3	6.6	3	8.5	2	5.4	1	3.8
Aspergillus niger	5	16.6	4	18.1	2	4.4	3	8.5	1	2.7	1	3.8
Curvularia geniculate	2	6.6	0	0	3	6.6	2	5.7	2	5.4	0	0
Fusarium sps.	2	6.6	1	4.5	3	6.6	2	5.7	2	5.4	0	0
Paccilomyces sps.	1	3.3	1	4.5	3	6.6	2	5.7	1	2.7	0	0
Penicillium citrinum	0	0	1	4.5	3	6.6	0	0	5	13.5	4	15.3
Penicilium nigricans	0	0	0	0	3	6.6	4	11.4	5	13.5	4	15.3
Penicillium oxalicum	1	3.3	0	0	1	2.2	0	0	5	13.5	4	15.3
Penicilium sps.	1	3.3	0	0	1	2.2	2	5.7	5	13.5	4	15.3
Rhizoctonia sps.	1	3.3	1	4.5	3	6.6	3	8.5	2	5.4	0	0
Rhizopus nigricans	1	3.3	1	4.5	1	2.2	0	0	0	0	0	0
Rhizopus nodulus	1	3.3	0	0	2	4.4	2	5.7	0	0	2	7.6
Rhizopus stolonifer	0	0	1	4.5	4	8.8	3	8.5	1	2.7	1	3.8
Trichoderma sps.	0	0	0	0	3	6.6	2	5.7	1	2.7	2	7.6
Trichoderma viridae	0	0	0	0	3	6.6	1	2.8	1	2.7	1	3.8
Total colonies	30		22		45		35		37		26	
Number of species	12		10		18		14		15		12	

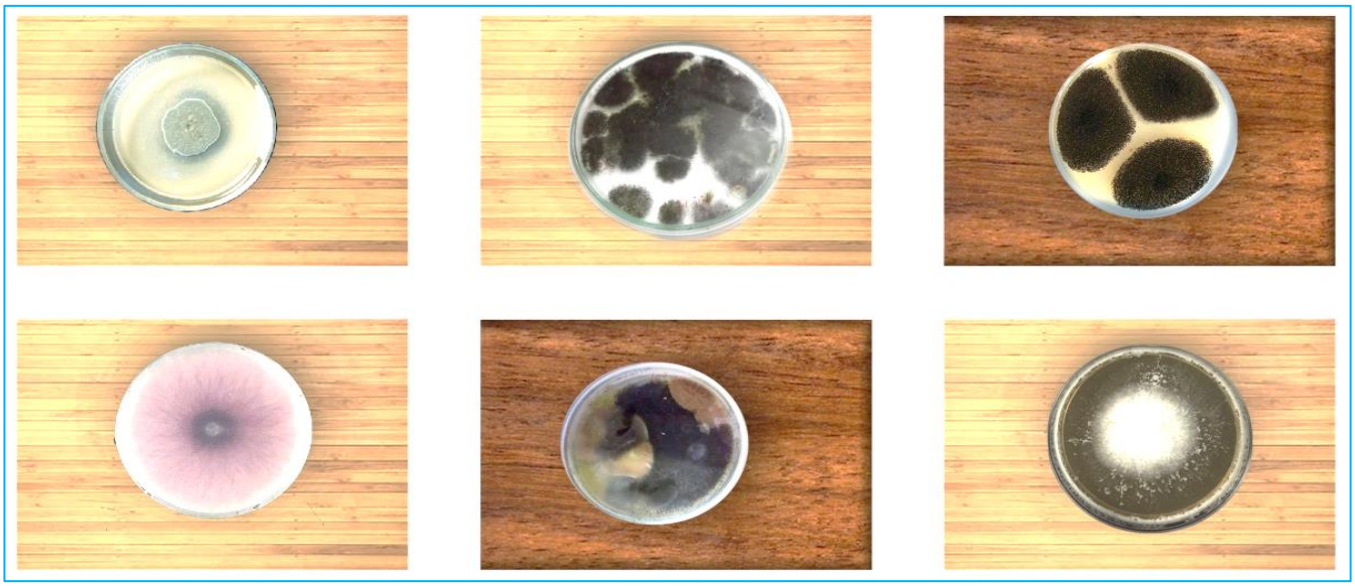

Photo plate 1 Fungal colonies of rhizosphere soil on PDA

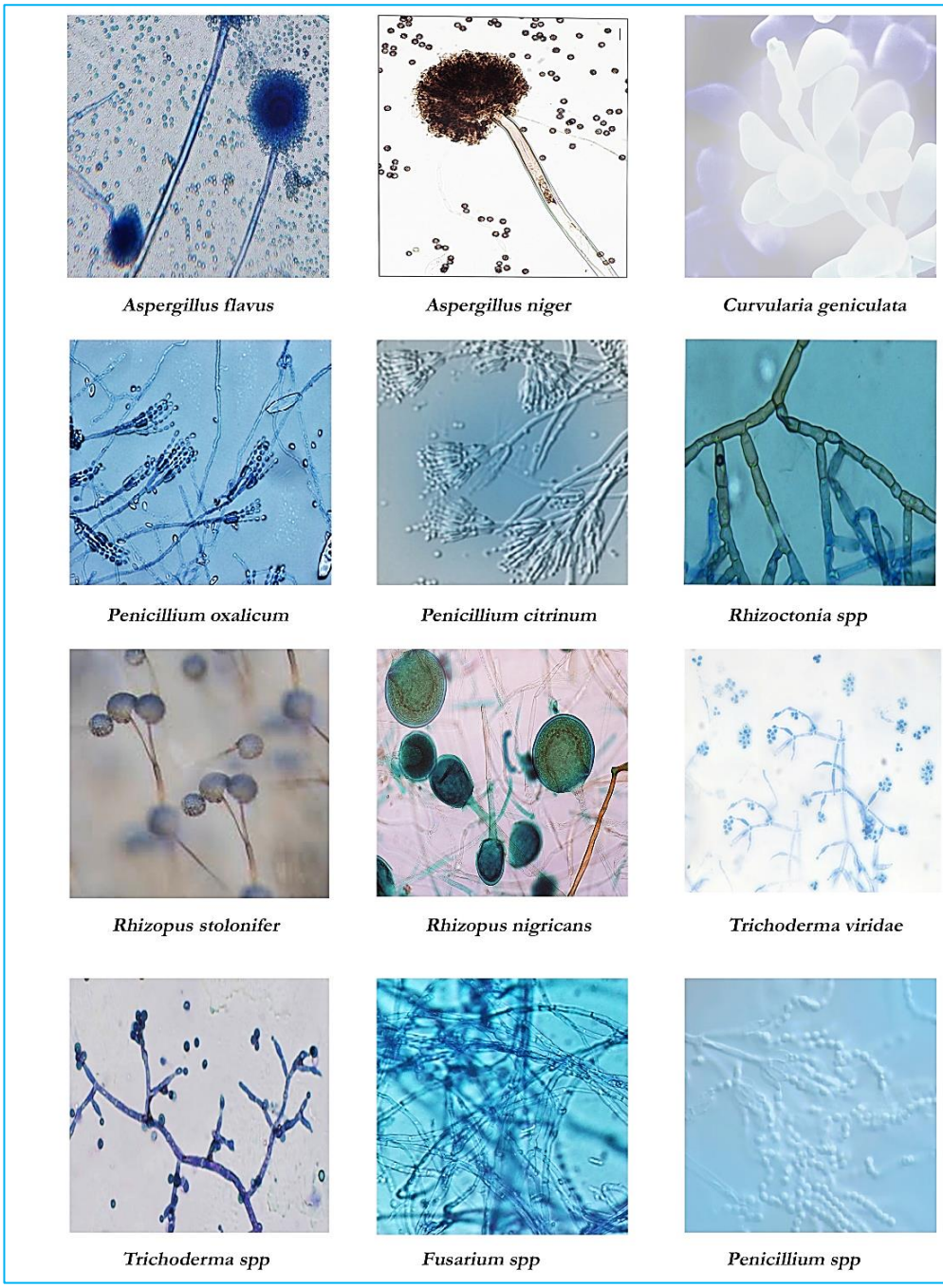

Photo plate 2 Microscopic structure of isolated fungi

CONCLUSION

Present study revealed that, fungal diversity recorded highest of field 3 in rainy season of Sakri tahasil and lowest of field 6 in summer season of Shindkheda tahasil. So, it is concluded from our finding rainy season should be preferable for rhizosphere fungal population than summer season. Fungal diversity also corelated with physicochemical parameters of soil. A significant corelation was observed between fungal population with soil pH, moisture content and soil texture. Result reveals that acidic pH and optimum moisture content, silt and clay, soil texture hold good amount of moisture. Which is most favourable condition growth of fungi our result accordance to previous finding of above researchers.

Acknowledgement

Authors are sincerely thankful to the Principal and Head, Research Centre, P. G. Department of Botany, SSVPS's Late Karmaveer Dr. P. R. Ghogrey Science College, Deopur, Dhule, MS, India. Kavita Patil is grateful to Mahatma Jyotiba Phule Research and Training Institute (MAHAJYOTI), Nagpur for granting financial assistance to conduct this research work.

LITERATURE CITED

1. Raaijmakers JM, Paulitz TC, Steinberg C, Alabouvette C, Moenne-Loccoz Y. 2009. The rhizosphere: a playground and battlefield for soilborne pathogens and beneficial micro-organisms. *Plant Soil* 321: 341-361. doi: 10.1007/s11104-008-9568-6.
2. Bridge P, Spooner B. 2001. Soil fungi: diversity and detection. *Plant Soil* 232: 147-154.
3. Waksman SA. 1921. A method for counting the number of fungi in the soil. *Journal of Bacteriology* 7(3): 339-341. doi: 10.1128/jb.7.3.339-341.1922.
4. Saravankumar K, Kaviyaeasan V. 2010. Seasonal distribution of soil fungi and chemical proportion of montatne wet temperate forest type of Tamil Nadu. *African Journal of Plant Science* 4(6): 190-196.
5. Gaddeyya G, Shiny P, Niharika, Bharathi P, Ratna Kumar PK. 2012. Isolation and identification of soil mycoflora in different crop fields at Salur Mandal. *Advances in Applied Science Research* 3(4): 2020-2026.
6. Waksman SA. 1994. Tree decades with soil fungi. *Soil Science* 58: 89-114.
7. Marschner P, Kandeler E, Marschner B. 2003. Structure and function of the soil microbial community in a long-term fertilizer experiment. *Soil Biol. Biochem*. 35: 453-461.
8. Manoharachary C. 1976. Distribution of some *Aspergilli* and *penicillium* in different soils. *Geobios* 3(2): 69-70.
9. Gangawane LV, Deshpande KB. 1972. Microbial ecology in some forest soils of Maharashtra- 1, Rhizosphere micro-fungi of some common trees of Ajanta hills. *Marathwada University Journal of Science* B(11): 1-4.
10. Reddy VN, Prakash P, Manoharachary C. 1987. Fungistasis in forest soil using the dominant soil fungi. *Biome*. 2(1): 126-128.
11. Manoharachary C, VRT, Reddy, U Prasad. 1990. Distribution and phenology of soil fungi supporting forest vegetation. *Geophytology* 20(2): 58-70.