Plant Archives
Journal home page: www.plantarchives.org
DOI Url: https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no1.033

DIVERSITY AND DISTRIBUTION OF SOIL FUNGI ISOLATED FROM THE CABBAGE (*BRASSICA OLERACEA VAR. CAPITATA*) RHIZOSPHERE

Muneer Ahmad Khan[1] and Ashfaque M. Khan[2]

[1]Department of Botany, Government Degree College Uri, Jammu and Kashmir (INDIA)
[2]Department of Botany, Maulana Azad College of Arts, Science and Commerce, Aurangabad (M.S., INDIA)
E-mail: mahmadkhan824@gmail.com
E-mail: ashfaqamk@gmail.com

(Date of Receiving-23-09-2020; Date of Acceptance-18-12-2020)

ABSTRACT

We have been working on the traditional way to discourse microscopic fungal population present in the rhizospheric soil of Cabbage (*Brassica oleracea var. capitata*). These fungi are crucial for the decomposition of organic carbon, cycling of nitrogen and phosphorus, and belowground carbon sequestration. Their role as parasite, saprophyte, mutualism and commensalism is also well established. The objective of this study was to analyze soil and determine the fungus genera from the rhizospheric soil of Cabbage from the area of Armpora, Binner, Chakloo, Janbazpora, Ladoora, Muslimabad, Nadihal and Punchatra villages which come under, Dist. Baramulla, Jammu and Kashmir. The Cabbage plant rhizospheric soil was obtained from various research locations marked from the said villages. Research method applied was a survey with the intent of soil sampling. The soil samples were taken from 1-10 cm deep soil for sampling purpose. The result recorded from soil samples were then analyzed descriptively and described based on their macro and micro morphology. Then, the collected fungus was identified by using identification manual for fungus. Fungi such as *Aspergillus, Alternaria, Chaetomium, Cladosporium, Curvularia, Fusarium, Mortirella, Mucor, Nigrospora, Penicillium, Rhizoctonia, Phoma, Trichoderma, Verticillium and Sterilia mycelia* were most frequently recorded.

Keywords: Dist. Baramulla, Cabbage Plant, Rhizosphere, Fungus Genera

INTRODUCTION

The rhizosphere is the soil environment directly under the influence of living roots (Kent and Triplett 2002). Soil in general is home to a large number of fungi species that unite with different forms of life strategies. Fungi play important roles in many ecosystem functions and services, especially those that involve soil (Treseder and Lennon 2015 and Dighton, 2016), where they make up an estimated 55–85% of the microbial biomass (Waring *et al.,* 2013, Joergensen and Emmerling 2006). These fungi are crucial for the decomposition of organic carbon, cycling of nitrogen and phosphorus, and belowground carbon sequestration (Treseder and Lennon 2015, Gougoulias *et al.,* 2014, Ritz and Young 2004). Soil fungi also indirectly contribute to ecosystem function through their interactions with primary producers. For instance, they affect plant growth and community composition through pathogenic attacks on particular plant taxa, changes to plant–plant competition, and beneficial interactions that ameliorate environmental stress (Begum *et al.,* 2019, Latef *et al.,* 2016, Ferrol *et al.,* 2019, Fr *et al.,* 2018, Powell and Rillig 2018). A study conducted in 2001 suggested that as few as 150,000 fungal species can be found in soil (Bridge and Spooner, 2001), but a review from 2007 increased that number to as many as 1.5 million species of fungi that can be found in terrestrial soils around the globe (Barrios, 2007). Microbial communities in the soil drive number of critical functions (Quince *et al.,* 2008), which is why they are often referred to as the 'functional backbones' of terrestrial ecosystems (van der Heijden *et al.,* 2008). . Saprophytic fungi play a role in overhauling complex compounds in nature. The existence of the filament structure leads the fungus to penetrate the substrate by using its hyphae. Fungi have a high enzymatic ability in decomposing organic compounds including lignin and cellulose compounds (Cromack and Caldwell 1992). Oligotrophic, slow growing bacteria feed on more recalcitrant substrates. In particular the more recalcitrant fractions of litter are more efficiently decomposed by saprotrophic fungi (van der Wal *et al.,* 2013). Despite high functional redundancy, certain functions can be reduced or lost when microbial diversity declines (Singh *et al.,* 2014).

MATERIALS AND METHODS

Rhizosphere Soil Sampling : Rhizospheric soil samples were collected from the location of Cabbage plant during growing season of crop (July 2019 to September 2019) from the said villages in Baramulla district. Rhizosphere soil samples were taken from 1-10 cm deep soil and brought to research laboratory in sterile recyclable polythene bags. Soil sampling was carried out using a Purposive Random Sampling Method.

Isolation of the Rhizospheric Fungi : Soil samples were diluted to 10^{-6}. Then in dilutions 10^{-5} and 10^{-6} they are isolated on Potato Dextrose Agar (PDA) medium through spread plate method and incubated at 25± 26^{0}C for one to five days for 24 hours. After the fungal colony growth, purification and counting of the fungal colonies was done.

Table 1: -Distribution of Isolated species at different locations

Sr. No	Species/ Location	Armpora	Binner	Chakloo	Janbazpora	Muslimabad	Nadihal	Ladoora	Punchatra
1	*Alternaria alternata*	+	-	+	-	-	++	+	-
2	*Aspergillus. Niger*	++	++	++	+++	++	++	+	++
3	*A. fumigates*	++	+	+	++	+++	+	++	+++
4	*A. terreus*	-	+	+	-	+	-	-	-
5	*A. terricola*	+	-	-	-	+	+	+	+
6	*A. nidulans*	++	+	++	+	+	+	+	+
7	*A. viride-nutans*	+	-	-	-	-	+	-	-
8	*Chaetomium cupreum*	-	+	-	+	++	-	-	+
9.	*Cladosporium spp.*	+	+	+	-	-	+	+	-
10	*Curvularia eragrostidis*	-	-	+	+	-	+	+	++
11	*C. lunata*	-	+	-	+	-	-	-	-
12	*Fusarium lateritium*	+++	+	++	+	++	++	+	++
13	*F. oxysporum var, redolens*	++	++	+	+	+++	++	+	+++
14	*F. solani*	++	+	++	++	++	+++	+	+
15	*Mortierella elongata*	-	-	+	-	-	-	+	-
16	*M. humilis*	-	-	-	+	-	-	-	+
17	*Mucor indicus*	++	++	+++	+	+	+	++	++
18	*M. mucedo*	-	+	-	+	-	-	-	-
19	*M. plumbeus*	++	+++	+	--	+	-	-	++
20	*Nigrospora sp.*	-	+	-	+	-	-	+	-
21	*Penicillium fellutanum*	+	+	-	++	-	-	-	+
22	*P. oxalicum*	-	-	-	-	+	+	-	-
23	*P. restrictum*	-	+	-	-	+	-	-	+
24	*P.variabile*	+	+	+	-	+	-	-	-
25	*Phoma leveillei*	+	++	+	++	+	+	-	++
26	*Rhizoctonia solani*	-	+	++	++	-	-	++	+
27	*Trichoderma harzianum*	+	++	+	++	+	+	+	-
28	*T. virens*	-	-	-	+	-	+	++	+
29	*Verticillium*	++	+	++	+	-	+	-	++
30	*Sterile mycelia*	+++	+++	+++	+++	+++	+++	+++	+++

*Distribution= +++ high Diversity, ++ moderate diversity, + low diversity Nil-

Table: 2 Climate and Soil type at each sampling location

S no.	Villages	Annual High and Low Temperature (0C)	Annual Precipitation (mm)	Soil Type
1.	Armpora,	24.3/-4.1	32.1	Silt Loamy Brown
2.	Binner	25.2/-3.5	31.5	Silt Loamy Brown
3.	Chakloo	24.8/-4.2	31.5	Silt Loamy Brown
4.	Janbazpora	24.0/-3.7	32.3	Silt Loamy Brown
5.	Ladoora	25.4/-4.1	32.7	Silt Loamy Brown
6.	Muslimabad	24.9/-4.0	31.9	Silt Loamy Brown
7.	Nadihal	25.1/-3.6	31.8	Silt Loamy Brown
8.	Punchatra	24.5/-4.3	32.6	Silt Loamy Brown

Number Individual Conversions: Individual counts obtained on petri dishes were completed by counting the number of colonies or individuals in each dilution. The individual obtained was determined by multiplying the number of colonies formed by the dilution factor. If there are the same individuals in different plates, the multiplication results were averaged (Ferdiaz, 1992).

RESULTS AND DISCUSSION

The results recorded from the rhizospheric soil samples of the Cabbage plants are as depicted in table 1. Total 14 fungal genuses were screened from the marked research area location in the Dist. Baramulla. It was found that Genus *Aspergillus* was dominant in all type of soil forms

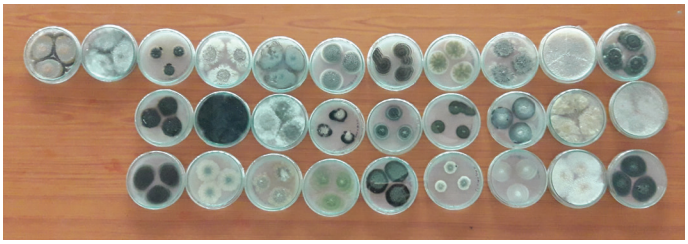

Plate-01: Fungal Isolates from Cabbage Rhizospheric Soil

followed by *Fusarium, Mucor, Penicillium, Rhizoctonia and Mycelia sterilia*. Out of total isolates screened 6 species of *Aspergillus* were identified, 4 species of *Penicillium*, 3 species of *Fusarium*, 3 species of *Mucor,* 2 each of *Curvularia*, *Mortierella* and *Trichoderma* were identified. Each single species of *Alternaria, Chaetomium, Cladosporium, Nigrospora, Phoma, Rhizoctonia* and *Verticillium* were also identified. In number of isolated Sterlie mycelia was also encountered. Soils are of silt loam to clay texture and fine granular sub angular blocky structure. Soil Organic carbon and total nitrogen contents are nearly uniform upto 60 – 70 cm depth. Soils are slightly too moderately alkaline (pH 7.8 – 8.3). Soils contain upto 10% calcium carbonate. Their water holding capacity exceeds 40%. \

The Diversity and distribution of fungi in soil is influenced by several factors. According to (Marschner *et al.,* 2003), that the distribution size of organisms is often influenced by the abundance and characteristics of soil organic matter content, climatic conditions, vegetation surface, and soil texture. The environment factor, pH of soil, soil texture did not show any significant difference in diversity and distribution of fungi in all villages. The results of soil texture analysis in the rhizosphere of the plant shows it is silt loamy brown. It is assumed that variation in the fungal distribution in the Cabbage plants is due to the influence of exudates produced by the roots of each plant. According to (Soemarno, 2010) plant roots provide organic material which generally stimulates microbial growth. According to (Parkinson *et al.,* 1963) young roots are colonized initially by a diversity of soil fungi, which after some days, are substituted by a more restricted mycobiota staying in the same until the senescence of roots. Overall the objective of this study was fulfilled by results showing presence of diverse mycoflora distributed all around the selected research area in Dist. Baramulla of Jammu and Kashmir.

CONCLUSION

Based on results obtained from eight villages selected for rhizosphere of cabbage plant soil sampling showed presence of 14 fungal genera. They are *Aspergillus, Alternaria, Chaetomium, Cladosporium, Curvularia, Fusarium, Mortirella, Mucor, Nigrospora, Penicillium, Rhizoctonia, Phoma, Trichoderma, Verticillium and Sterilia mycelia*

REFERENCES

Barrios E. 2007. Soil biota, ecosystem services and land productivity. *Ecol Econ*. 64(2): 269-285.

Begum, N.; Qin, C.; Ahanger, M.A.; Raza, S.; Khan, M.I.; Ashraf, M.; Ahmed, N.; Zhang, L. 2019. Role of Arbuscular Mycorrhizal Fungi in Plant Growth Regulation: Implications in Abiotic Stress Tolerance. *Front. Plant Sci.* 10, 1068.

Bridge P, Spooner B. 2001. Soil fungi: diversity and detection. *Plant and Soil*. 232(1-2): 147-154.

Cromack K and Caldwell B A 1992. The Role of Fungi in Litter Decomposition and Nutrient Cycling In Carroll, J C and Wicklow D T (eds.) The Fungal Community : Its Organizations and Role in the Ecosystem 2nd ed (New York: Mar-cel Dekker) pp 653-68

Dighton, J. Fungi in Ecosystem Processes; 2016. CRC Press: Boca Raton, FL, USA.

Ferdiaz S 1992 Mikrobiologi Pangan I (Jakarta: Gramedia Pustaka Utama)

Fr ¸ac, M.; Hannula, S.E.; Bełka, M.; J ¸edryczka, M. 2018. Fungal Biodiversity and Their Role in Soil Health. *Front. Microbiol*. 9, 707. [CrossRef]

Ferrol, N.; Azcón-Aguilar, C.; Pérez-Tienda, J. Review 2019. Arbuscular mycorrhizas as key players in sustainable plant phosphorus acquisition: An overview on the mechanisms involved. *Plant Sci.* 280, 441–447. [CrossRef]

Gougoulias, C.; Clark, J.M.; Shaw, L.J. 2014. The role of soil microbes in the global carbon cycle: Tracking the below-ground microbial processing of plant-derived carbon for manipulating carbon dynamics in agricultural systems. *J. Sci. Food Agric*., 94, 2362–2371.

Joergensen, R.G.; Emmerling, C. 2006. Methods for evaluating human impact on soil microorganisms based on their activity, biomass, and diversity in agricultural soils. J. *Plant Nutr. Soil Sci*., 169, 295–309.

Kent, A. D. and E. W. Triplett 2002. Microbial community and their interactions in soil and rhizosphere ecosystems. *Annu. Rev. Microbiol.* 56: 211-236.

Latef, A.A.H.A.; Hashem, A.; Rasool, S.; Abd_Allah, E.F.; Alqarawi, A.A.; Egamberdieva, D.; Jan, S.; Anjum, N.A.; Ahmad, P. 2016. Arbuscular mycorrhizal symbiosis and abiotic stress in plants: A review. *J. Plant Biol.,* 59, 407–426.

Marschner P, Kandeler E and Marschner B 2003. Structure and Function of the Soil Microbial Community in a Long Term Fertilizer *Experiment Soil Biology and Biochemistry* 35 453-61

Parkinson, D., Taylor, G.S; Pearson, R. 1963. Studies of Fungi in root region. I. The development of fungi on young roots. *Plant soil,* 19:332-349,

Powell, J.R.; Rillig, M.C. 2018. Biodiversity of arbuscular mycorrhizal fungi and ecosystem function. *New Phytol.,* 220, 1059–1075.

Quince C, Curtis TP, Sloan WT 2008. The rational exploration of microbial diversity. *The ISME Journal 2* (10): 997-1006.

Ritz, K.; Young, I.M. 2004. Interactions between soil structure and fungi. Mycologist, 18, 52–59.

Singh, B.K., Quince, C., Macdonald, C.A., Khachane, A., Thomas, N., Al-Soud, W.A. *et al*. 2014. Loss of microbial diversity in soils is coincident with reductions in some specialized functions. *Environmental Microbiology*, 16, 2408– 2420.

Soemarno 2010. Ekologi Tanah Bahan Ajar Mata Kuliah Manajemen Agroekosistem (Malang: Universitas Brawijaya)

Treseder, K.K.; Lennon, J.T. 2015. Fungal traits that drive ecosystem dynamics on land. *Microbiol. Mol. Biol. Rev.* 79, 243–262.

Van der Heijden MGA, Bardgett RD, van Straalen NM 2008. The unseen majority: soil microbes as drivers of plant diversity and productivity in terrestrial ecosystems. *Ecology Letters 11* (3): 296-310.

Van der Wal A, Geydan TD, Kuyper TW, de Boer W 2013. A thready affair: linking fungal diversity and community dynamics to terrestrial decomposition processes. FEMS *Microbiology Reviews* 37 (4): 477-494.

Waring, B.G.; Averill, C.; Hawkes, C.V. 2013. Differences in fungal and bacterial physiology alter soil carbon and nitrogen cycling: Insights from meta-analysis and theoretical models. *Ecol. Lett*., 16, 887–894.