CORPUS PUBLISHERS

Environmental Sciences and Ecology: Current Research (ESECR)

Volume 2 Issue 4, 2021

Article Information

Received date : May 23, 2021

Published date: July 24, 2021

***Corresponding author**

Somdatta Ghosh, Department of Botany (UG &PG), Midnapore College, India

Keywords

Host plants; Wildfire; Bacteria; Prolonged drought

Mini Review

Impact of Fire Incidences in Forest on Soil Microbes and Arbuscular Mycorrizae

Somdatta Ghosh*

Department of Botany (UG &PG), Midnapore College, India

Abstract

Both wildfire and prescribed burning results in imbalance in forest ecosystem by direct or indirect effects on soil, plants and microbes. The impact of fire varies with some factors-frequency and severity of fire, types of forest, plant species and edaphic properties. Most observations reported negative effect on soil micro-biota and increasing with fire severity, though bacteria are less affected than fungi, community alteration occurs for both. Reports on arbuscular mycorrhiza fungi are not enough; yet show alteration of species composition, abundance and colonization pattern, though help host plants to recover.

Introduction

Incidences of forest fire are reasoned for both wildfires, occurring mostly naturally, sometimes manmade and prescribed or controlled fire as part of forest management system. Wildfire occur worldwide in different ecosystems, seasons and for different causes, lightning, volcanic eruptions, dry season, prolonged drought etc. as dry shoot, leaf litter or resin increases flammability. Lightning induced fire increased highly after 2000 [1]. According to Catalanotti [2], biomass burning practice in and adjacent area of forest leading to wildfire is very common in some countries. Controlled or prescribed fire in forest floor in early spring is a common practice and part in forest management worldwide. Wade and Lunsford [3] defined prescribed burning as "fire applied in a knowledgeable manner to forest fuels on a specific land area under selected weather conditions to accomplish predetermined, well-defined management objectives". Prescribed burning is actually a burn plan that is a written procedure specific for the area including the objective, the restrictions, the desired fire effects, a map of the burning unit and the prescriptions [4]. The primary objective of prescribed burning is obviously for wildfire risk reduction. The objectives of prescribed burning are:- Reduce forest fire incidence by reducing inflammable materials in forest floor as- logs, litters; specially coniferous forest; Prepare sites for seed germination and establishment, especially for short time viable seeds; improve wildlife habitat; control plant disease; improve access of nutrients by adding ashes and fasten nutrient cycle [5]. The prescribed burning too sometimes become out of control for wind velocity, dry environment, lack of man power or negligence. Exhaustive analyses of effect of fire on forest animals, soil structure, microbial community, nutrient cycle, global increment of greenhouse gases, pathogen attack chances of fire injured plants, deformed timber; actually a study on ecosystem is needed to judge its necessity for all types of forest [6]. As heat, stress significantly affects plant growth and development by imparting

1) Loss of plant vigor and inhibition of seed germination,
2) Retarded growth rate,
3) Decreased biomass production,
4) Wilting and burning of leaves and reproductive organs,
5) Abscission and senescence of leaves,
6) Damage as well as discoloration of fruit,
7) Reduction in yield and cell death and
8) Enhanced oxidative stress [7].

Burning also affect soil physicochemical properties and soil biota. Fire had a strong negative effect on soil biota biomass, abundance, richness, evenness, and diversity. Fire reduced nematode abundance by 88% but had no significant effect on soil arthropods [8]. Negative effect on soil micro-biota, specially, mycorrhiza may affect the nutrient cycle in long run.

After Effect of Wild Fire on Plant and Soil

Post effects of fire vary with these factors:- season, weather, wind, precipitations, types of plant community composition, Phenology of trees, slope, topography, fuel load, soil moisture and soil organic matter content were also [9-11]. Phenologic status of the plant is directly related with the season. Depending on their growth stage, growing tissues are more sensitive to high temperatures than the dormant [12]. Types of vegetation is most important factor as some species are fire hardy, some adapted to fire for regeneration, others sensitive to fire [13,14]. In most cases, juveniles are adversely affected than mature trees. Spring fire was found to promote seedling emergence of shrub species in Australian grass-woodlands, and had little influence on seedling survival. In some cases, fire generates positive effects on plant communities, e.g. by rejuvenating, accelerating germination, by creating a mosaic of different vegetation types, resulting increasing biodiversity [12]. Reduced water availability can have important impacts on the competitive outcomes of neighbouring plants. These conditions favor invasion of non-mycorrhizal plants, mainly exotics and obnoxious weeds [15]. Fire may affect forest soil at different extents depending on its severity. Heat transfer to soil damages soil, therefore the most important factors is fire intensity [16] and duration [16, 17]. Soil heating mostly affects litter and humus layers AO or OO harbouring different beneficial microbes governing nutrient cycle. The temperature when rises to above 200 °C, organic matter in the upper layers vaporize leading formation of water-repellent soils [18]. During precipitations, the layer starts to disintegrate and soil structure breaks causing soil erosion [9]. The higher intensity fire results into complete loss of soil organic matter and volatilization of nitrogen, phosphorus and potassium but very high temperature is required for complete burning of Mn, Mg, Cu and other micronutrients. The soil microorganisms are mostly affected by high temperature. Effect of prescribed fire on physical, chemical, and biological properties [19] has been studied in different

How to cite this article : Somdatta Ghosh (2021) Impact of Fire Incidences in Forest on Soil Microbes and Arbuscular Mycorrizae. Environ Sci Ecol: Curr Res 2: 1025

forest ecosystems showed different results. Responses to fire vary in forest ecosystem types [20], fire severity [21]; fire type and frequency [20] and on the type of soil and vegetation cover [22]. Over by et al. [23] found significantly higher concentrations of soil ammonia and nitrate in the burned canopy areas, while available phosphorus appeared greater but this was not statistically significant. De Bano et al. [24] found that fire acted as a rapid mineralizing agent and that removal of the tree canopy further stimulated the mineralization of both nitrogen and phosphorous. Availability of nutrients after burning is often a short-term phenomenon [25] and long-term alteration of soil structure [17]. The removal by fire of organic matter at the soil surface and in the top few centimetres of mineral soil can cause changes in soil structure. These changes may include decreases in soil pore size, which could lead to increased surface water runoff and erosion, and reduced water retention within the mineral soil. Increased burning frequency can reduce soil organic matter content and alter nitrogen availability [17].

Effect on Microbial Community

Burning can exert a positive, negative, or neutral effect on soil organisms that are often species specific [26]. Some microbes return to their original structure after some period of time [27]. Effects of prescribed burning on soil microorganisms in a Minnesota Jack pine forest showed to increase Streptomyces proliferation [28]. Relationship between microbial community structure and soil environmental conditions is variably correlated in a recently burned system [29]. It is observed that although there is a decrease in abundance of microbes following fire, the remaining microbes can have levels of activity that are greater than that of the microbial community prior to the fire [30]. These authors found that the increased rates of microbial processes, such as denitrification and production of methane and carbon dioxide, persisted for one year following fire. Sandra [31] observed in burned stands had a 52% and 56% reduction in soil microbial biomass and basal respiration respectively. Within burned stands, they found that microbial biomass and basal respiration was significantly declined with increasing fire severity, which in turn reduced the capacity of the soil microbial community to decompose soil cover for longer time scales. Fire severity can more strongly reduce microbial biomass [32, 33], and shift bacterial communities [33], compared to lower severity. The loss in microbial biomass during a fire depends upon the intensity and duration of the fire [34, 35]. Severe fire evidenced with reduced microorganism biomass and abundance up to 96%. Bacteria were more resistant to fire than fungi [8]. Microbial biomass nitrogen (Nmic) of pine forest was reduced by 22.2% to 37%, whereas in the oak forest its values were 8.8% to 16.3% in uttarakhand, India. The overall change in soil microbial biomass carbon was 63% and 40% at the burnt oak forest and burnt pine forest, respectively. [36]. Shen et al. [37] repoted long term repeated fire disturbance alters soil bacterial diversity but not the abundance in an Australian wet sclerophyll forest. Arthrobacter sp. and Blastococcus sp were found significantly increased in post-fire soils in a holm-oak forest in Spain [38]. Arthrobacter sp. was also found in a varied ecosystem of Canadian Boreal forest [39]. Arthrobacter may be able to survive fires due to its ability to resist starvation, desiccation and oxidative stress [40] drawing nutrition from fire-affected aromatic C sources [41] and may play a role in post-fire nitrogen cycling [42]. Arthrobacter may play an important role in the post-fire microbial ecosystem and increases in plant biomass. Penicillium is a common saprotrophic forest micro fungus [43], found growing in severely burned sites as first colonizer, and may be for the post-fire availability of nutrient and carbon source [44]. Mucor [45] too enhanced. Some other fire responsive bacteria found were Neurospora sp [46], Geopyxis sp [47] and Massilia sp [39] Aeromicrobium, Burkholderia Paraburkholderia [48]. Fimetariella rabenhorstii was significantly enriched with fire in boreal forest [49]. These most abundant fire-responsive bacterial taxa are genetically identical in the sequenced region to organisms that have been identified as aromatic C-degraders [50, 51] and most with significantly higher mean predicted 16S gene copy numbers for communities from more severely burned Sites; and most fire responders favour a low acidic pH while negative fire responders prefer neutral to high pH soil [40]. Members of Betaproteobacteria and Bacillus were only detected from the DNA left in the burnt site three months after the fire in a Pinus canariensis forest. Wildfire had a very pronounced negative effect on the soil microbial community not only in terms of its resistance to fire, but in resilience too.

Effect on Arbuscular Mycorrhizae

The incidence of forest fire decreases the actinomycetes, fungal population and arbuscular mycorrhizal fungi (AMF) [52]. Generally, AMF-inoculated plants show better growth under heat stress than do the non-AMF-inoculated ones [53]. Different results from individual studies in different ecosystems and forests have hindered to reach a general conclusion about correlation among fire, mycorrhizal fungi, and ecosystem function. For example, studies have shown that wildfire can have negative [7, 54], neutral [55], or positive [56] effects on fungal diversity. Similarly, many studies have found an overall decrease in mycorrhizal colonization in post fire [57], while other studies have found no effect [58] or even increased colonization following fire [59]. Much of the published information appears contradictory, largely reflecting differences in experimental methodologies, fire intensities and timescales of the various studies [17]. Available information, however, suggests that soil fungal communities may be more sensitive to fire than bacterial community richness [51, 60]. In general, mycorrhizal taxa displayed particularly low tolerances for severe fire. Severe fires can yield greater mortality for host plants of symbiotic microbes as mycorrhizal fungi [56], reducing fungal abundance [61], and fungal diversity [56] density and alteration of species composition, which did not mediated by changed soil abiotic properties as before [62]. On the other hand, mycorrhizal fungi regulate C gains to the soil by facilitating the transfer of nutrients to plant roots [63]. Thus, the consequences of increased wildfire activity for soil C storage in boreal forests could depend on the sensitivities of each fungal group to fire severity. In moderate fire intensity, temperature not directly affect AM, but indirect affect by damage of host plant organ, in low severity they survive in host root and help to regenerate host by exploiting stored nutrients in cortical vesicles [58, 64]. Hewitt et al. [56] examined shifts in fungal community composition with fire severity in Alaskan tundra, and noted that relative abundance of dominant taxa tended to decline with fire severity. More severe burns tended to eliminate mycorrhizal fungi, lack of host plant is the another cause of resilience. Effect of fire frequency showed short intervals decreased overall root colonization, while long intervals arbuscular colonization, though presence of host plant is a factor [65] or availability of nutrients from slash in post fire period [66, 67]. Mycorrhizal colonization also decreases after fire when measured in situ [20]. Repeated burning overall may not affect fungal richness [20], but distinct fire-adapted fungal communities do develop in frequently burned forests (two- and three-year intervals [68]. Barraclough and Olsson [66] reported root colonization is known to both increase and decrease depending on the plant species and AM type, independently of changes in AM fungal abundance in post fire soil in dry tropical forest. Actually different AM species differ in degree of resilience. A recovery trend of microbial biomass was found in Boreal forests [69] and fungal richness in different sites [20], but these effects realized in long time after the fire.

Conclusion

Major research reports are done in temperate forest and effects on ectomycorrhizal, though fire incidents are very common in dry deciduous and tropical forests, information are not plenty. More works need to be done in these forests and affect microbial diversity and functions to assess the necessity of controlled burning or its interval.

References

1. Styger J, Marsden Smedley J, Kirkpatrick JB (2018) Changes in lightning fire incidence in the Tasmanian wilderness. World Heritage Area Fire 1: 38.
2. Catalanotti AE (2009) Effects of prescribed burningon soil and vegetation. Thesis Department of Structural and Functional Biology.
3. Wade DD, Lunsford JD (1989) A guide for prescribed fire in southern forests. Tech Publ R8-TP11 Atlanta GA: US Department of Agriculture, Forest Service, Southern Region Pp. 56.
4. Knapp E, Estes E, Becky L, Skinner CN (2009) Ecological Effects of Prescribed Fire Season: A Literature Review and Synthesisfor Managers. JFSP SynthesisReports p. 4.
5. Tolhurst KG, McCarthy GJ (2016) Effect of prescribed burning on wildfire severity: a landscape-scale case study from the 2003 fires in Victoria. Australian Forestry 79: 1-14.
6. Lal R (2004) Soil carbon sequestration to mitigate climate change. Geoderma 123: 1-22.
7. Hernández Rodríguez M, Oria de Rueda JA, Martín Pinto P (2013) Post-fire fungal succession in a Mediterranean ecosystem dominated by Cistus ladanifer L. Forest Ecology and Management 289: 48-57.
8. Pressler Y (2018) Below ground community responses to fire: meta-analysis reveals contrasting responses of soil microorganisms and mesofauna. Dryad Digital Repository.
9. Neary DG, Ryan KC, De Bano LF (2005) Fire effects on soil and water. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-42 p. 4.
10. Ryan KC (2002) Dynamic interactions between forest structure and fire behavior in boreal ecosystems. Silva Fennica 36(1): 13-39.
11. Van Wagner CE (1983) Fire behavior in northern conifer forests and shrublands. (In:), Wein RW, MacLean DA, (Eds.), The role of ecosystems. Scope 18. John Wiley

and Sons, New York, USA 65-80.

12. Brown JK, Smith JK (2000) Wildland fire in ecosystems: effects of fire on flora. Gen Tech Rep RMRS-GTR-42, 2. Ogden, (Brown JK, Smith JK, Eds.). UT: US. Department of Agriculture, Forest Service, Rocky Mountain Research Station Ppp. 257.
13. Franklin J, Spears Lebrun LA, Deutschman DH, Marsden K (2006) Impact of a high–intensity fire on mixed evergreen and mixed conifer forest in the Peninsular Ranges of Southern California, USA. Forest Ecology and Management 235: 18-29.
14. Knox KJE, Clarke PJ (2006) Fire season and intensity:a temperate sclerophyllous woodlands. Oecologia 149: 730-739.
15. Chandra KK, Bhardwaj AK (2015) Incidence of Forest Fire in India and Its Effect on Terrestrial Ecosystem Dynamics, Nutrient and Microbial Status of Soil. International Journal of Agriculture and Forestry 5(2): 69-78.
16. De Bano LF, Neary DG, F folliott PF (1998) Fire's effects on ecosystems. John Wiley & Sons, New York, USA Ppp. 333.
17. Neary DG, Klopatek CC, DeBano LF, Ffolliott PF (1999) Fire effects on belowground sustainability: a review and synthesis. Forest Ecology and Management 122: 51-71.
18. De Bano LF (1981) Water repellent soils: a state of the art. USDA Forest Service, General Technical Report, PSW-46, Berkeley, CA.
19. Huseyin E (2006) Effect of forest fire on some physical, chemical and biological properties of soil in Çanakkale. Int J Agric Biol 8(1): 102-106.
20. Dove NC, Hart SC (2017) Fire reduces fungal species richness and in situ mycorrhizal colonization: a meta-analysis. Fire Ecol 13: 37-65.
21. Gongalsky KB (2006) Forest fires as a factor of formation of soil animal communities. Zhurnal Obshchei Biologii 67: 127-138.
22. Rojas I.R, Lugo SF, Sierra JRA, Fernández MP (2016) Effect of fire on soil microbial composition and activity in a Pinus canariensis forest and over time recovery. Geophysical Research Abstracts 18: 1-13118.
23. Overby ST, Moir WH, Robertson GT (2000) Soil and Vegetation Changes in a Pinyon–Juniper Area in Central Arizona after Prescribed Fire. Proceedings RMRS-P-13.
24. De Bano LF, Perry HM, Overby ST (1987) Effects of fuelwood burning on biomass and nutrient relationships in a pinyon–juniper stand. Proceedings Pinyon Juniper Conference 382-386.
25. Uhl C, Jordan CF (1984) Succession and nutrient dynamics following forest cutting and burning in Amazonia. Ecology 65: 1476-1490.
26. Coyle DR (2017) Soil fauna responses to natural disturbances, invasive species, and global climate change: current state of the science and a call to action. Soil Biol Biochem 110: 116-133.
27. Allison SD, Martiny JBH (2008) Resistance, resilience and redundancy in microbial communities. Proc Natl Acad Sci 105: 11512-11519.
28. Ahlgren IF, Ahlgren CE (1965) Effects of prescribed burning on soil microorganisms in a Minnesota Jack pine forest. Ecology 46: 306-310.
29. Hamman ST, Burke IC, and Stromberger ME (2007) Relationships between microbial community structure and soil environmental conditions in a recently burned system. Soil Biology and Biochemistry 39: 1703-1711.
30. Poth M, Anderson IC, Miranda HS, Miranda AC, Riggan PJ (1995) The magnitude and persistence of soil NO, N2O, CH4 and CO2 fluxes from burned tropical savannain Brazil. Global Biogeochemical Cycles 9: 503-513.
31. Sandra H R, Brendan MR, Kathleen K, Treseder J, Sandra T R Holden R et al. (2016) Fire severity influences the response of soil microbes to a boreal forest fire. Environ Res Lett 11: 035004.
32. Fioretto A, Papa S, Pellegrino A (2005) Effects of fire on soil respiration, ATP content and enzyme activities in mediterranean maquis. Appl Vegetation Sci 8: 13-20.
33. Knelman JE, Graham EB, Trahan NA, Schmidt SK, Nemergut DR (2015) Fire severity shapes plant colonization effects on bacterial community structure, microbial biomass, and soil enzyme activity in secondary succession of a burned forest Soil Biol. Biochem 90: 161-168.
34. Girona García A, Badía Villas D, Martí Dalmau C, Ortiz Perpiñá O, Mora J et al. (2018) Effects of prescribed fire for pasture management on soil organic matter and biological properties: a 1-year study case in the Central Pyrenees. Sci Total Environ 618: 1079-1087.
35. Lucas Borja ME, Miralles I, Ortega R, Plaza Álvarez PA, Gonzalez Romero J, et al. (2019) Immediate fire induced changes in soil microbial community composition in an outdoor experimental controlled system. Sci Total Environ 696: 134033.
36. Singh D, Sharma P, Kumar U, Daverey A, Arunachalam K (2021) Effect of forest fire on soil microbial biomass and enzymatic activity in oak and pine forests of Uttarakhand Himalaya, India. Ecological Processes 10: 29.
37. Shen J, Chen C, Lewis R T (2016) Long term repeated fire disturbance alters soil bacterial diversity but not the abundance in an Australian wet sclerophyll forest Scientific Reports 6: 19639.
38. Fernández González AJ, Martínez Hidalgo P, Cobo Díaz JF, Villadas PJ, Martínez Molina E, et al. (2017) The rhizosphere microbiome of burned holm-oak:potential role of the genus Arthrobacter in the recovery of burned soils. Scientific Reports 7: 6008.
39. Whitman T, Whitman E, Wooleta J, Parisien MA, Flannigанm M, et al. (2019) Soil bacterial and fungal response to wildfires in the Canadian boreal forest across a burn severity gradient. Soil Biology and Biochemistry 138: 107571.
40. Manzanera M, Narváez Reinaldo JJ, García Fontana C, Vílchez JI, González López J (2015) Genome sequence of Arthrobacter koreensis 5J12A, a plant growth-promoting and desiccation-tolerant strain. Genome Announcements 3: e00648-15.
41. Westerberg K, Elvang AM, Stackebrandt E, Jansson JK (2000) Arthrobacter chlorophenolicus sp nov, a new species capable of degrading high concentrations of 4-chlorophenol. International Journal of Systematic and Evolutionary Microbiology 50: 2083-2092.
42. Cobo Díaz JF, Fernández González AJ, Villadas PJ, Robles AB, Toro N, et al. (2015) Metagenomic assessment of the potential microbial nitrogen pathways in the rhizosphere of a mediterranean forest after a wildfire. Microbial Ecology 69: 895-904.
43. Lumley TC, Gignac LD, Currah RS (2011) Microfungus communities of white spruce and trembling aspen logs at different stages of decay in disturbed and undisturbed sites in the boreal mixed wood region of Alberta. Canadian Journal of Botany 79: 76-92.
44. Mikita Barbato RA, Kelly JJ, Tate RL (2015) Wildfire effects on the properties and microbial community structure of organic horizon soils in the New Jersey Pine lands. Soil Biology and Biochemistry 86: 67-76.
45. Aydin S, Karaçay HA, Shahi A, Gökçe S, Ince B, Ince O (2017) Aerobic and anaerobic fungal metabolism and Omics insights for increasing polycyclic aromatic hydrocarbons biodegradation. Fungal Biol Rev 31: 61-72.
46. Jacobson DJ, Powell AJ, Dettman JR, Saenz GS, Barton MM, et al. (2004) Neurospora in temperate forests of western North America. Mycologia 96: 66-74.
47. Greene DF, Hesketh M, Pounden (2017) Emergence of morel (Morchella) and pixie cup (Geopyxis carbonaria) ascocarps in response to the intensity of forest floor combustion during a wildfire. Mycologia 102: 766-773.
48. Thijs S, Sillen W, Truyens S, Beckers B, van Hamme P, et al. (2018) The sycamore maple bacterial culture collection from a TNT polluted site shows novel plant-growth promoting and explosives degrading bacteria. Frontiers of Plant Science 9: 136.
49. Krug JC (1995) The genus Fimetariella. Can J Bot Rev 73: 1905-1916.
50. Liu J, Liu S, Sun K, Sheng Y, Gu Y, et al. (2014) Colonization on root surface by a phenanthrene-degrading endophytic bacterium and its application for reducing plant phenanthrene contamination. PLoS One 9: e108249.
51. Guo M, Gong Z, Miao R, Rookes J, Cahill D, (2017) Microbial mechanisms controlling the rhizosphere effect of ryegrass on degradation of polycyclic aromatic hydrocarbons in an aged-contaminated agricultural soil. Soil Biology and Biochemistry 113: 130-142.
52. Gavito ME, Olsson PA, Rouhier H, Medinapeñafiel A, Jakobsen I, et al. (2005) Temperature constraints on the growth and functioning of root organ cultures with arbuscular mycorrhizal fungi. New Phytol 168: 179-188.
53. Maya MA, Matsubara Y (2013) Influence of arbuscular mycorrhiza on the growth and antioxidative activity in Cyclamen under heat stress. Mycorrhiza 23 (5): 381-390.

54. Martín Pinto P, Vaquerizo H, Peñalver F, Olaizola J, Orie de, et al. (2006) Early effects of a wildfire on the diversity and production of fungal communities in Mediterranean vegetation types dominated by Cistus ladanifer and Pinus pinaster in Spain. Forest Ecology and Management 225: 296-305.

55. Chen DM, Cairney JWG (2002) Investigation of the influence of prescribed burning on ITS profiles of ectomycorrhizal and other soil fungi at three Australian sclerophyll forest sites. Mycological Research 106: 532-540.

56. Hewitt RE, Bent E, Hollingsworth TN, Chapin FS, Taylor DL (2013) Resilience of arctic mycorrhizal fungal communities after wildfire facilitated by resprouting shrubs. Eco science 20: 296-310.

57. Dhillion SS, Anderson RC, Liberta AE (1988) Effect of fire on the mycorrhizal ecology of little bluestem (Schizachyrium scoparium). Canadian Journal of Botany 66: 706-713.

58. Eom A, Hartnett DC, Wilson GWT, Figge DAH (1999) The effect of fire, mowing and fertilizer amendment on arbuscular mycorrhizas in tallgrass prairie. The American Midland Naturalist 142: 55-70.

59. Herr DG, Duchesne LC, Tellier R, McAlpine RS, Peterson RL (1994) Effect of prescribed burning on the ectomycorrhizal infectivity of a forest soil. Int J Wild land Fire 4: 95-102.

60. Bååth E, Frostegård Å, Pennanen T, Fritze H (1995) Microbial community structure and pH response in relation to soil organic matter quality in wood-ash fertilised, clear-cut or burned coniferous forest soils. Soil Biology and Biochemistry 27: 229-240.

61. Bergner B, Johnstone J, Treseder KK (2004) Experimental warming and burn severity alter soil CO2 flux and soil functional groups in a recently burned boreal forest Glob. Change Biol 10: 1996-2004.

62. Silvana Longo, Eduardo N, Bruno T, Goto RL, Berbara CU (2014) Effects of fire on arbuscular mycorrhizal fungi in the Mountain Chaco Forest. Forest Ecology and Management 315: 86-94.

63. Clemmensen KE, Bahr A, Ovaskainen O, Dahlberg A, Ekblad A, et al. (2013) Roots and associated fungi drive long-term carbon sequestration in boreal forest Science 339: 1615-1618.

64. Bellgard SE, Whelan RJ, Muston RM (1994) The impact of wildfire on vesicular arbuscular mycorrhizal fungi and their potential to influence the re-establishment of post-fire plant communities. Mycorrhiza 4: 139-146.

65. Torpy F, Morrison D, Bloomfield B (1999) The influence of fire frequency on arbuscular mycorrhizal colonization in the shrub Dillwynia retorta (Wendland) Druce (Fabaceae). Mycorrhiza 8: 289-296.

66. Barraclough AD, Olsson PA (2018) Slash and Burn Practices Decrease Arbuscular Mycorrhizal Fungi Abundance in Soil and the Roots of Didierea madagascariensis in the Dry Tropical Forest of Madagascar. Fire 1 (37): 26.

67. Johnson NC (2010) Resource stoichiometry elucidates the structure and function of arbuscular mycorrhizas across scales. New Phytol 185: 631-647.

68. Oliver AK (2015) Soil fungal communities respond compositionally to recurring frequent prescribed burning in a managed south eastern US forest ecosystem. For Ecol Manage 345: 1-9.

69. Dooley SR and Treseder KK (2012) The effect of fire on microbial biomass: a meta-analysis of field studies. Biogeochemistry 109: 49-61.

Citation: Somdatta Ghosh (2021) Impact of Fire Incidences in Forest on Soil Microbes and Arbuscular Mycorrizae. Environ Sci Ecol: Curr Res 2: 1025