



Fire impact on chemical and physicochemical parameters in a dry deciduous forest of Melghat

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ABSTRACT:

Effects of a wildfire on soil chemical and physical properties in a Melghat forest (north – western compact block) extending over 3075 Sq km. in the Amravati district of Maharashtra) were investigated. Response of the soil during the first two years following a wildfire was examined, where data from soil in a burned forest were compared to that in an adjacent, unburned soil. The effects that wildfire have on soil properties in this highly fragmented ecosystem are not well understood, but results from this study suggest similar responses to those found in other Mediterranean forest systems. Both physical and chemical properties were examined, and data presented here suggest that soil properties vary in their initial response to fire in this ecosystem. Na and K does not alter in burn and unburned soil, total nitrogen also remain same. While total organic carbon increases, electric conductivity also increases. TOC: TN ratio also increases. The available phosphorus increases sharply which may result in the P^{HI} 6.5. The results of this study have implications for the productivity and sustainable management of the native forest remnants that remain in this region.

Key words: soil chemical properties, soil physical properties, wildfire, burned soil, unburned soil.

INTRODUCTION:

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the biodiversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. It happens particularly during summer, with colossal loss of vegetation cover of that region. Forest fires are considered to be a potential hazard with physical, biological, ecological and environmental consequences (Jaiswal *et al.*, 2002). As per (Jhariya and Raj, 2014) fire is a big disaster in the forest causes a loss of natural resources, depleting of soil biomass resulting loss of various mobile nutrient. Impact of forest fire is varies from vegetational structure of forest community, availability of fuel load, frequency, intensity and fire return interval of that forest. Globally, biomass fires are burning between 3-4.5 million Km² per year, this is area equivalent to India plus Pakistan or more than half of Australia (Chatenoux and Peduzzi, 2012). However, impacts from biomass fires are numerous and severe. They include loss of soil cohesion from heat, which then accelerate soil erosion (from wind or rain), it destroys complex ecosystems and thus has a significant impact on biodiversity, it emits GHG, and biomass fires are responsible for 17.4% of GHG global emissions (Solomon *et al.*, 2007). Fires may also play a significant role in regulating ecosystem productivity and diversity by promoting mineralization of nutrients stored in organic matter and allowing the invasion of rapid growing early successional species (Boerner *et al.*, 2009). Fire leads to important change in physical, chemical and biological properties of soil, which

are relevant for the future productivity and sustainability of ecosystem (Neary *et al.*, 2005). (Wang *et al.*, 2012) reported that fire increases C and N availability and increase microbial activity, which consequently decreases the potential rates of C sequestration. The extent and duration of these effects on soil properties depend on the intensity and residence time, fire severity (Certini, 2005).

Organic matter is a key factor for forest soil. It has a direct and /or an indirect influence on all physical and chemical characteristics of the soil. While low severity fires, such as those prescribed for forest management, have been reported to have transient but positive effect on soil fertility, severe wildfire result in significant losses of soil organic matter, and nutrient, and deterioration of the overall physical-chemical properties of soil that determine its fertility, such as porosity, structure among others (Certini, 2005).

The study of the burned soil is necessary to analyze the soil degradation, not only to estimate the modification of the nutrient content but either the physicochemical characteristics of the organic matter.

The objective of this research was to study, several soil parameters related to chemical soil fertility, chemical and physicochemical properties (through different analytical techniques). To review the effect of wildfire on flora, fauna and various property of soil, which are important in maintaining healthy ecosystem.

MATERIAL AND METHODS:

Melghat forest, the north – western compact block is extending over 3075 Sq km. in the Amravati district of Maharashtra. It is situated on the branch of Gavilgarh being the name of the fort on the one of the southern spurs. This forest is dry deciduous forest with some patches of semi evergreen at higher plateaus. Melghat Tiger Reserve, Gugamal National Park, Melghat

Sanctuary, and territorial forest are the components of Melghat forest.

METHOD:

Two composite samples were taken from the upper layer (0-10 cm) of soil, some days after the wildfire occurrence and before any rainfall event. The samples were taken from the burned (BS) and adjacent unburned soil (UBS), at the same sampling moment. Litter and the ash were not removed from the soil surface before sampling in the unburned and burned soil, respectively. The samples were air-dried, crushed and passed through a 2 mm sieves before all the analytical analysis

The samples of burned and unburned soil were analyzed for pH at a rate 1:2.5 (w:v), electric conductivity (EC), total nitrogen content (TN) by the Kjeldahl method, phosphorus available (P) by Bray & Kurtz method (1945), total organic carbon (TOC) by combustion at 540 °C for 4hrs. (Abad, *et al.*, 2002).

RESULTS AND DISCUSSION:

Table: 1. Principal chemical characteristic of burned and unburned soil.

Sr.no	Sample	P ^H	E.C.	TN	TOC	TOC/TN	P	Na	K
1	S1 UBS	6.21	0.60	7.6	111	14.61	18.0	0.26	1.15
2	S1 BS	6.53	1.18	8.1	138	17.04	48.3	0.25	1.02

S1 = Sample 1, UBS = Unburned soil, BS = Burned soil.

The effect of burning onto soil Total Nitrogen (TN) content present a paradox, which have been debated for years (Neary *et al.*, 1999; Knicker & Skjemstad, 2000). (Certini 2005), suggested that organic N could be volatilizes and in part mineralized to ammonium. (Santín *et al.* 2008) found that the TN after fire increase and (González-Vila *et al.* 2009) suggest that wildfire promote the accumulation of recalcitrant organic-N forms. The N, would be as NH₄⁺ or NO₃⁻, the NH₄⁺ could be adsorbed onto negative charge of mineral and/or organic surface, but with time transformed to NO₃⁻. Nitrate, without any plant uptake, will be lost from the ecosystem either by denitrification or leaching (Certini, 2005; Knicker, 2007) The electric conductivity (EC) increase in the burned soil, it could be assigned to the release of inorganic ions from the combusted organic matter present as litter or ash; this increase could be temporary (Hernandez, *et al.*, 1997; Certini, 2005).

Organic matter

The most intuitive expected change in the soils during a fire event is the loss of organic matter. This change depends on the fire severity, vegetation type, soil texture and even slope. The impact on the organic matter consist of slight distillation (volatilization of minor constituents), charring or complete oxidation. Substantial consumption of organic matter begins in the 200-250 °C range to complete at around 450-500 °C (Certini, 2005; Knicker, 2007). The influence of fire on the organic matter content have been reported a wide range of effects, showing even contrasting results (Czimczik *et al.*, Alexis *et al.*,

The results of the principal chemical parameters are shown in table 1. The concentration of the cations, such as Na⁺ and K⁺ were not altered by fire (Certini, 2005). The forest fires have not necessarily the same impact on soil P as on N, because losses of P through volatilization or leaching are small. The combustion of vegetation and litter causes modification on biogeochemical cycle of P. Burning convert the organic pool of soil P to orthophosphate, which is the form of P available to biota. Furthermore, the peak of P bioavailability is around pH 6.5. These could be the reason for which an enrichment of P is observed in the studied burned soil, but this enrichment will decline soon, because it precipitates as slightly available mineral forms (Certini, 2005; Cade-Menun *et al.*, 2000). In agreement with this suggestion, the increase in the available P content in this burned soil could be due to the soil pH value

2007) The total organic carbon (TOC) increase around 21%, this behavior could be attributed to the accumulation of recalcitrant hydrophobic fraction of organic matter (Gonzalez-Perez *et al.*, 2004; Santin *et al.*, 2008).

CONCLUSION:

Fire is a natural ecological disturbance factor in forest and these forests plays an important role to maintain ecosystem structure and their function and provide services include carbon storage, production of O₂, production of biomass (timber, fire wood) and production of pharmaceutical products. Wildfires create countless of environmental, social and economic impacts. Wildfire impacts includes total acres burned, cost of fire suppression, damage to homes and structures, alteration of wildlife habitat, damage to watersheds and water supply, damage to public recreation facilities, evacuation of adjacent communities, tourism impacts, damage to timber resources, destruction of cultural and archaeological sites, costs of rehabilitation and restoration, public health impacts, transportation impacts. To save the forest from scourge of fire is thus a central responsibility of forest managers in this area. From conservation point of view, maintaining and sustaining these all forest types is important as they harbor high biodiversity of not only plant species, but are also a preferred habitat for several wild animals. From management perspectives a participatory approach should incorporate for betterment of environmental conservation and ecological stability. Use of controlled fire, fire lines, fuel

breaks, fuel load removal and mapping of fire sensitive areas are key principles to minimize fire risk. Remote sensing and GIS is novel techniques for detection and monitoring systems for fire prediction and it must become an integral part of fire management.

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