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**Research Article**

# DYNAMICS OF CARBON CYCLING ENZYMES AND HUMUS CONTENT IN PLANT LITTER INCUBATED WITH SOIL

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**ABSTRACT**

A study was conducted with the objective to determine the humus content of surface and depth rhizosphere of 10 different plant species and concluded that the plant litters of *Delonix regia* are comparatively of best quality to be used as substrate by soil microbes and enzymes for decomposing and stabilizing it into humus. In support of the work, the change in activity of different carbon cycling enzyme has also determined in incubated soil alone and in soil with plant litter(50:1) for an interval of 20, 40 and 60 days respectively. 20 days incubation was found to be more effective in both except that of tyrosinase enzyme. The enzymes taken under consideration are dehydrogenase, phenol oxidase, peroxidase, laccase, cellulose and tyrosinase. Plant litters in soil have more enzymatic activity as compared to soil alone for all incubation periods.



## INTRODUCTION

Soil moves continually in a natural cycle aided by oxygen, water, minerals and decomposing animal and plant matter. These elements create life in the soil, which is ongoing if not disturbed. The production of humus is a complex process. In general, cyclic substances like phenol groups and also other like organic acids and vitamins (humus is also related to crude oil) are polymerized with help of enzymes. These cyclic compounds are both from plant parts (like lignin) and are also produced by the microorganisms. Mostly fungi, actinomycetes (*Streptomycetes*) seem to be responsible for humus formation. *Aspergillus, Pisolithus, Rhizoctonia, Streptomycetes* are only but a few examples of microorganisms actually capable of synthesizing cyclic (aromatic) compounds and form them into humus from non-cyclic materials. It is impossible for man to produce stable humus synthetically.

Litter is considered to be a key organic source of carbon input into the soil, so litter decomposition plays a crucial role in the Earth's carbon budget. Litter decomposition influences soil biogeochemistry of plant stands and affects the formation of soil organic matter (SOM). Due to its decomposability litter affects organic carbon accumulation in the soil and, consequently, stabilization of SOM (Lv and Liang, 2012). SOM, in turn, determines important soil properties, including its fertility. The mechanisms of carbon stabilization in soils are still not well understood, although they have received much attention recently (Lutzow *et al*., 2006).Chemical as well as physical changes occur in stabilization of SOM. Chemical change include the formation of humic substances, which are either aromatic (humic and fulvic acids) or aliphatic (humin) in character (Aiken, 1985; Song *et al*., 2011; Abakumov *et al*., 2013). Litter quality is considered to be one of the most important drivers of litter decomposition (Kara *et al*., 2014).

The objective of the study is to evaluate the percentage of humus content on the surface of rhizosphere and to a depth of 20cm of different plants present within the university campus. The main emphasis of the work is to study the decomposition pattern of Dalbergia sisoo litter in soil by calculating the changes in activity of carbon cycling enzymes under Dalbergia sisoo litters incubated with soil for 20, 40 and 60 days.

## MATERIALS AND METHODS

Several useful plant nutrients are released by humus after being decomposed by soil microorganisms ant this enhance the soil fertility. The humus content of the rhizosphere region gives the about the quality of litter decomposed by the soil microbes. 10 plants were selected randomly from the Mandsaur University campus for determining the humus content of their respective rhizosphere. Soil samples were collected from the surface and from the depth of 20cm from the surface. Standard Method

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(Pandey., 2010) was used to calculate the percentage of humus content of the collected soil samples.

For determining the dynamics of carbon cycling enzymes acidic red soil (pH 5.4) was collected from University campus, dried and sieved through 2mm sieve. Twigs, leaves and branches of *Dalbergia sisoo* was collected and air dried for 10 days to form litters. 10 gm litters were mixed with 500 gm soil and incubated for 20, 40 and 60 days in room temperature.

Dehydrogenase, Tyrosinase and Laccase activity was determined by the standard methods (Chhonkar *et al*., 2002).Standard methods (Robertson *et al*., 1999) were used for Phenol oxidase and Peroxidase activity determination. Cellulase activity was determined by using standard methods (Prado *et al*, 1998).

## RESULT AND DISCUSSION

Fig 01 shows the humus content percentage of 10 different plants' surface and depth rhizospheres. *Delonix regia* surface rhizosheral soil contains highest amount of humus contain concluding the best quality of litters with high content of carbon and nitrogen. For all the plants considered under the work surface soil has the high humus content as compared to the depth soil of 20 cm. It may be because humus from the beneath are rapidly used as carbon source by the roots as well the litter concentration s high on the surface as compared to the depth.

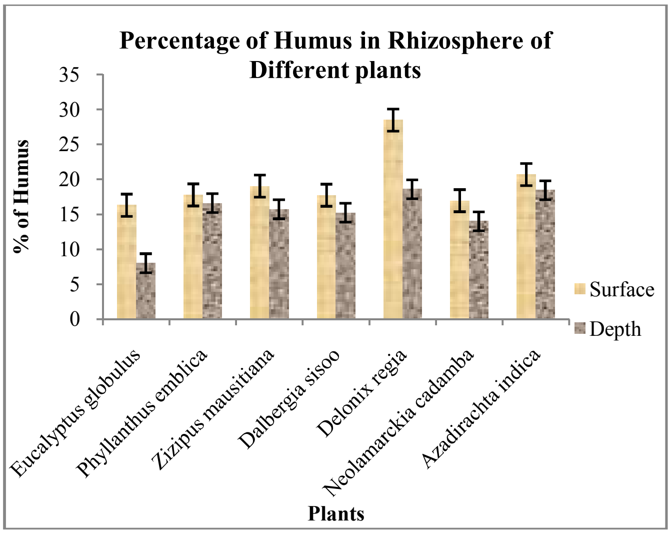


**Fig 1** Graphical representation of Percentage of humus content

Fig 2 to 7 represents the change in activity of different carbon cycling enzymes of soil alone and with *Dalbergia sisoo* litters (50:1). Dehydrogenase activity decreased with incubation period. The highest activity was 26.24µg TPF/g/hr in soil with plant litters after 20 days of incubation. There is no much difference in the activity of phenol oxidase and peroxidase within the treatments with various incubation periods. Soil with plant litters has much higher activity for laccase as compared to soil alone, which indicates the major role played by the plant litters in carbon stabilization and humus formation. Tyrosinase is one of the most important enzymes for humification reaction. The tyrosinase activity was seems to be increasing with incubation period .It is highest after 60 days incubation. It could be predicted to have high cellulose activity in soil with plant litters as litters would provide a good amount of cellulose substrate for high functioning of cellulose enzyme. Plant litter also increased the pH and EC value from 5.74 to 6.03 and from 0.569 to 1.084 respectively.

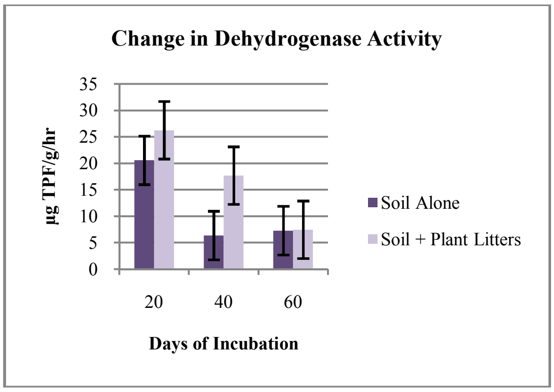


**Fig 2** Change in Dehydrogenase Activity

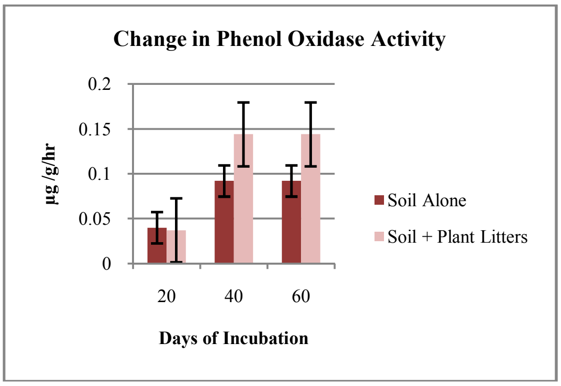


**Fig 3** Change in phenol oxidase Activity

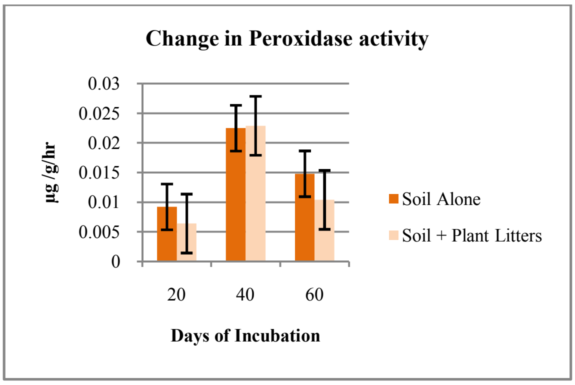


**Fig 4** Change in Peroxidase Activity

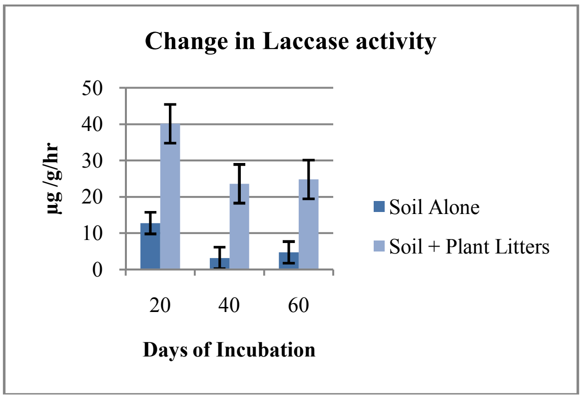


**Fig 5** Change in Laccase Activity

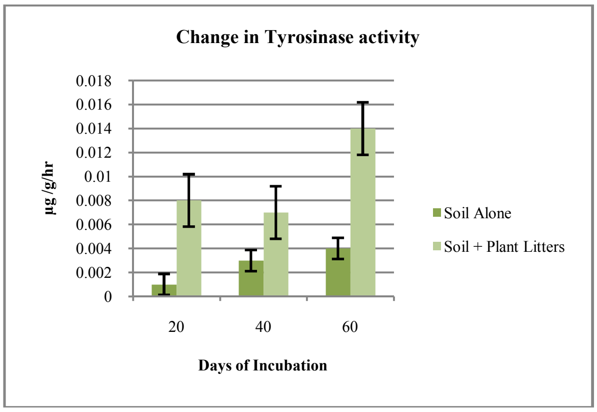


**Fig 4** Change in Tyrosinase Activity

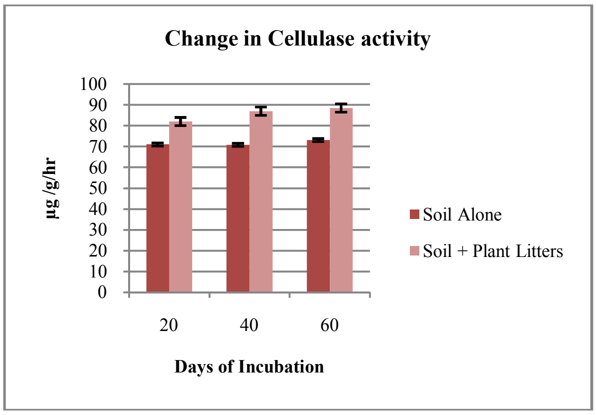


**Fig 5** Change in Cellulase Activity

## CONCLUSION

The work concluded that plant litter incubation period is highly responsible for carbon stabilization and for activation of carbon cycling enzymes. 20 days incubation shows the highest activity of most of the stabilizing enzymes which indicates highest rate of decomposition in this period, with limitation of plant litters as a substrate for enzymes, their activities slow down drastically after 40 and 60 days incubation respectively except tyrosinase enzyme. Apart from this, the study also revealed that the quality of plant litters for different species of plants also have positive impact in humus formation. In future further studies have to be carried out to study the effect of different chemical and biological agents isolated from environment only in humification rate so as to stabilize the soil pollutant and sewages to be used in agricultural lands.

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