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Research on the Decomposition Rate of Fungi Combination Based on EIO Competitive Ranking and Sigmoid Model

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Abstract: Litterfall decomposition speed affect the development of carbon cycle rate of ecosystems and biodiversity. As the main decomposer, fungui understands the decomposition characteris- tics of fungui to litterfall, which is a key step in exploring the carbon cycle process. We established a fungal combinatorial decomposition model, which uses growth rate and temperature-affected humidity resistance as independent variables. Then according to the EIO competitive ranking, the sigmoid model is used to calculate the weight of each fungui. Bringing into the above decomposition model, a comprehensive model of decomposition rate under a variety of flora environment is finally obtained.

1. Introduction

The carbon cycle is an important link to sustain life on earth. It describes the key process of carbon exchange in the entire geochemical cycle, as shown in Figure 1. Through the decomposition of the compound, the carbon can be renewed and used in other forms. Fungi is an important factor in the decomposition of wood fiber. Nicky Lustenhouwer's research has determined the characteristics of fungi that determine the decomposition rate in fungi. Researchers have studied a large number of fungi-related traits. [1] This article needs to pay attention to the growth speed of fungi and the moisture tolerance of fungi. There are many kinds of fungi that decompose wood fiber in the same area to establish related models.

2. Fungus combinatorial decomposition model

In order to study the decomposition effect of different kinds of fungi on the ground litter and wood fiber under different internal structure and external conditions, According to the research of Nicky Lustenhouwer and others, under the condition of temperature changes, fungi that grows slowly tend to grow better.[2] Fungi, which grows faster, cannot adapt well to environmental changes. The chemical structural formulas of lignin and cellulose are shown in the figure below.

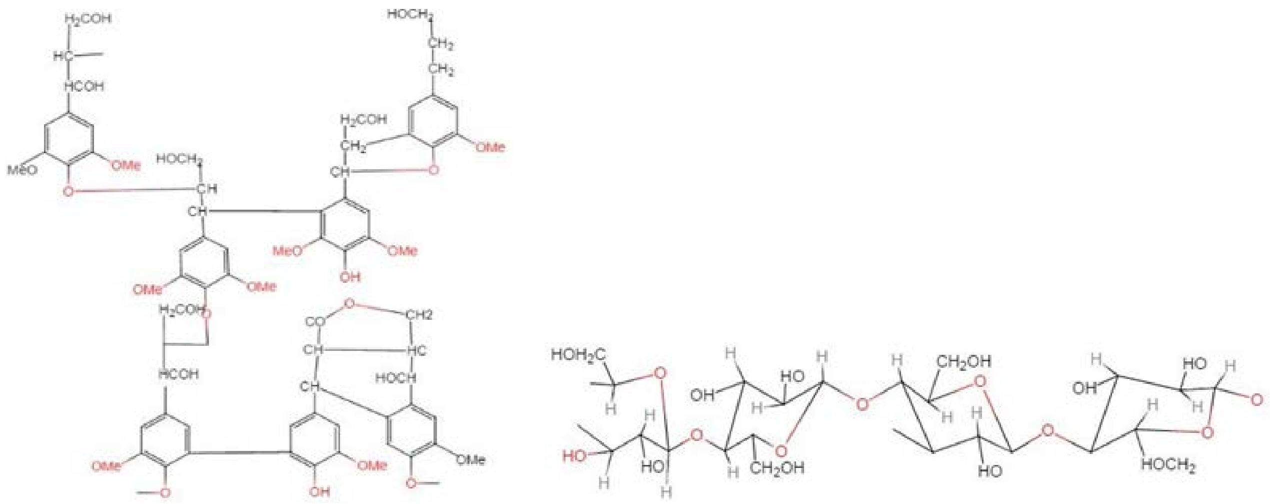

Figure 1: The chemical structure of lignin and cellulose

This article is expected to simulate the decomposition of fungi on a given land, using an experimental database of 20 species of 34 fungi. It is found that the temperature has a linear relationship with the expansion rate of the strain. According to the experimental data, the growth data of 34 types of strains and the external temperature were fitted by power series, and the fitting formula was as follows:

$$V_n = aT^b$$

The decomposition rate of fungi itself is related to the moisture tolerance. With the growth rate and humidity resistance as dependent variables, the function relationship can be obtained by fitting the image of the decomposition rate. The fitted image is shown in Figure 2.

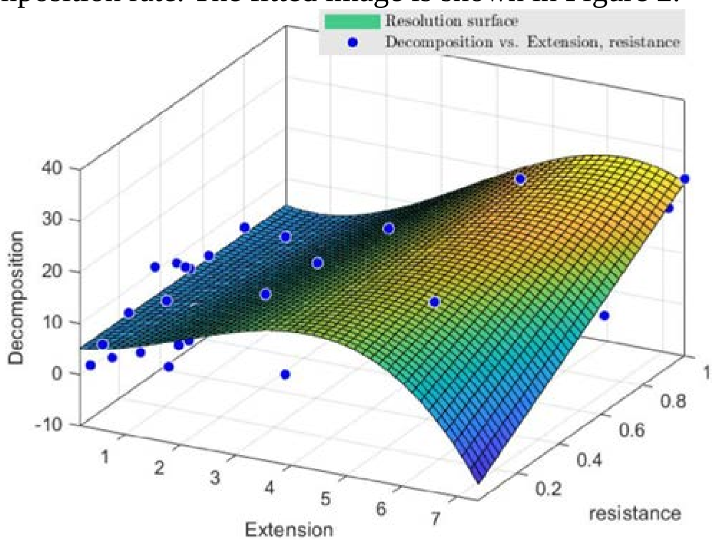

Figure 2: The relationship diagram of the influence of growth rate and moisture tolerance on decomposition

The functional relationship is as follows:

$$\begin{cases} \lambda = f(V_n, \theta) \\ f(x) = \rho + p10x + p01xy + p20x^2 + p11xy + p30x^3 + p21x^2y \end{cases}$$

The above function applies to all fungi conditions. In order to find the coexistence of multiple fungi under natural conditions, this article is divided into two cases. The first situation is that the space resources are sufficient, and the fungi communities do not constitute a competitive relationship. When the decomposition of each type of colony is linearly added, a fixed ratio is taken for each colony to obtain the same weight for each.

In the second case, when fungi grows to a certain extent, the lack of resources leads to competition among fungi. At this time, the decomposition efficiency is no longer a uniform addition of the decomposition rates of each strain. According to EIO competitive ranking, in order to make the data also fall in the [0,1] interval, this article uses the Sigmoid activation function to add biological characteristics to it,[3] redistribute weights.

The Sigmoid activation model is:

$$\begin{cases} S(ki) = \dfrac{1}{1+e^{-k_i}} \\ k_i = \dfrac{1}{34} \end{cases}$$

Bringing $S(k_i)$ and $f(x,y)$ into, you can get the fungi combinatorial decomposition model as:

$$\begin{cases} \lambda = \dfrac{\sum_{i=34} S(k_i) \cdot f(x,y)}{n = 34} \\ \lambda = \dfrac{\sum_{i=34} \dfrac{1}{1+e^{-k_i} \cdot (p00 + p10x + p01xy + p20x^2 + p11xy + p30x^3 + p21x^2y)}}{n = 34} \end{cases}$$

Using the Sigmoid function to activate the decomposition rate of fungus EIO competitive ranking and the comparison of the decomposition rate without interaction, the Figure 3 shows:

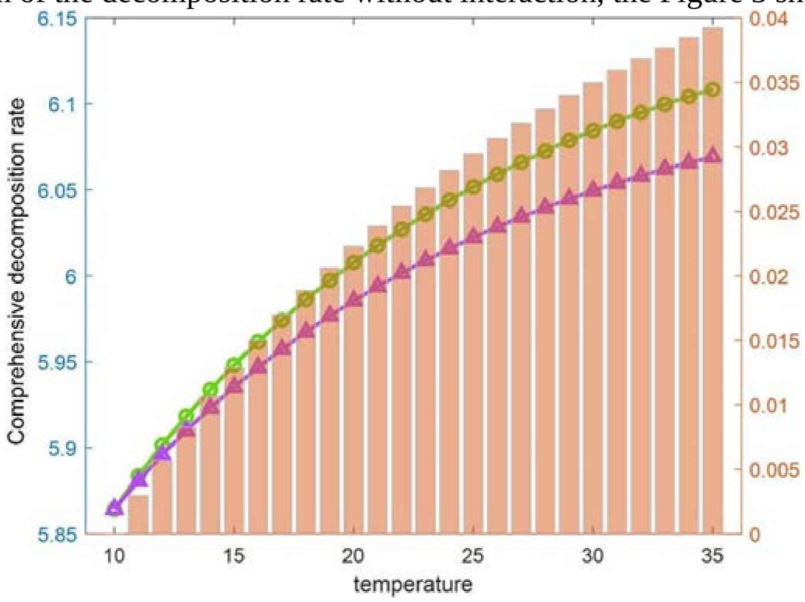

Figure 3: Comparison of decomposition rate after change

It can be seen from Figure 3 that during the competition period, the decomposition rate of lignin per unit mass of the flora has increased. Visualize the decomposition model of fungi communities with different moisture tolerances under temperature changes and bring in the temperature. The image is shown in Figure 4.

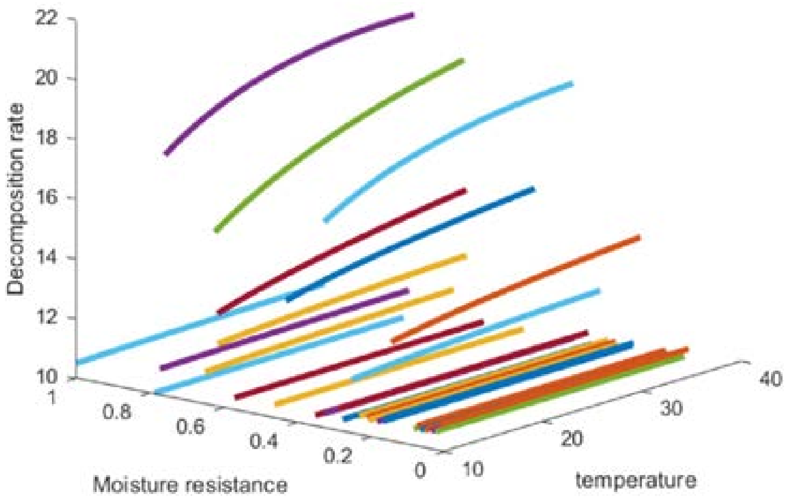

Figure 4: The lignin decomposition rate diagram of 34 types of fungi with different moisture tolerance under temperature changes

In this paper, it can be seen that under natural conditions, the competition among multiple fungi communities increases the decomposition rate of wood fiber.[4]

3. Conclusion

Fungi is considered to be the most important decomposers. There are 20 kinds of common fungal 34 classes, each fungi independent and restrict each other. The main factors affecting the decomposition rate of fungi are divided into internal factors and external factors.Intrinsic factors include fungi growth rate and moisture tolerance. Moisture tolerance is the difference between fungui EIO competitive ranking and its Moisture Niche Width. The growth rate is not only positively related to the decomposition rate, but related to the fungi stability. Slow-growing fungi can often survive and grow better under environmental changes such as humidity and temperature, while faster-growing strains often cannot grow robustly to the same changes. The external factors are temperature and living space limitations. The competition among multiple fungi communities accelerates the decomposition of wood fiber. When the external factors change, the diversity of the fungi community ensures the stability of the community and the stability of its decomposition ability, and it decomposes organic matter more effectively when faced with adverse environments.

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