

Study on fungal life activities of decomposing wood fibers

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Keywords: Fungi traits, Decomposition of woody fibers, Biodiversity, Differential equations

Abstract: The decomposition of plant material and woody fibers is a key component in the carbon cycle. In the whole process, fungi are the key factor to decompose wood fiber. A recent research indicates that there is a certain relationship between fungi traits that determine the decomposition rate. Based on the results of the research, our team construct a mathematical model to simulate the decomposition of ground litter and woody fibers in the presence of a variety of fungi and explore the decomposition under the condition of interaction, different environment, change of environment and biodiversity. In this paper, we start by analyzing the experimental data in the reference of the MCM problem A and we use the cluster analysis method to divide the fungi in the data into two groups according to the growth rate, competitiveness and environmental tolerance. Then on the basis of topic requirements, we construct our decomposition model that the decomposition rate of fungi per millimeter is only related to the growth rate of fungi population and the moisture tolerance of fungi and this relationship is linear. We use our decomposition model to add up the decomposition effects of the two types of fungi. Our conclusion is that the decomposition rate of fungal community was the sum of the decomposition rates of each fungal population.

1. Introduction

The carbon cycle refers to the exchange of carbon elements in the earth's biosphere, lithosphere, hydrosphere, and atmosphere, and it circulates with the movement of the earth. The decomposition of compounds is part of the carbon cycle, and its role is to transform carbon into other forms [1]. And the decomposition of plant materials and woody fibers is a key step in the decomposition of compounds. Wood fiber is an organic flocculent fiber material obtained by chemical treatment and mechanical processing of natural renewable wood. We know that many species of bacteria and fungi have the ability to decompose wood fibers, and the key factor in decomposing wood fiber is fungus [2].

Recently, a researcher has done a more in-depth study on the decomposition rate of fungi. He pointed out that some fungal traits determine the decomposition rate, and there are certain connections between these traits [3]. It is worth noting that the growth rate and environmental tolerance of fungi are inconsistent. In order to make a more detailed analysis of the carbon cycle, we built a small-scale mathematical model to simulate the decomposition activities of fungi, describing the interactions between fungi, and we take into account changes in geographic environment, weather and climate.

We also concluded that biodiversity plays an important role in the decomposition of woody fibers [4].

2. Decomposition Model

2.1 The classification of fungi

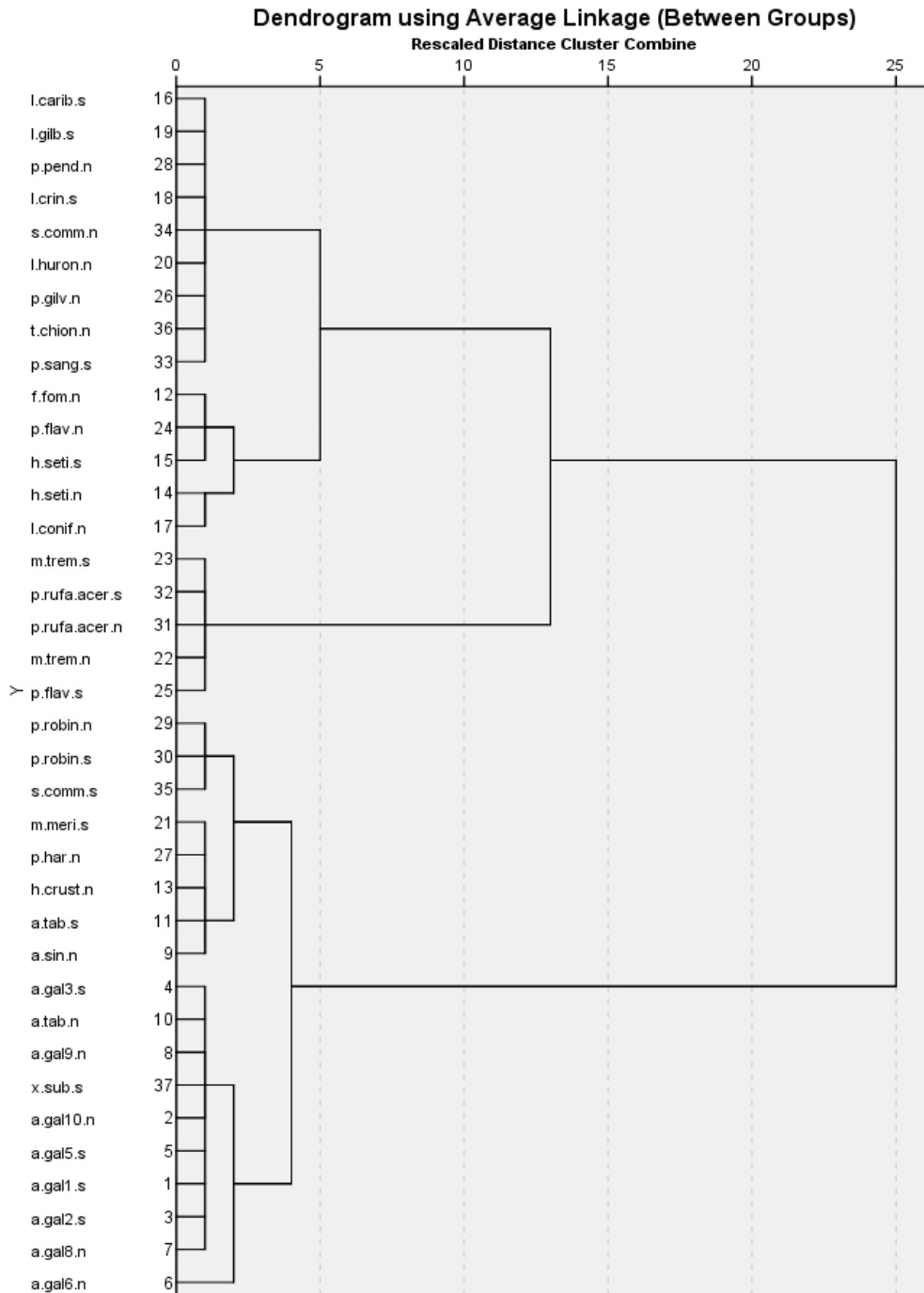


Figure 1

There are many kinds of fungi used in the original experiment in the reference. If each fungus is included in the model, it is too complicated, so we use the cluster analysis method to divide these

fungi into two categories. One type is fast growth, strong competitiveness, but poor tolerance to the environment, and the other type is slow growth, weak competitiveness, but strong tolerance to the environment. Our follow-up modeling will be based on the competition between these two fungi, without considering the internal competition [6].

Hierarchical cluster method was used to measure the standardized variable distance for clustering. The result of cluster analysis is shown in the figure below.

2.2 The model construction

According to the requirements of the topic, we build a decomposition model: the decomposition rate of fungi per millimeter v (g / day) is only related to the growth rate of fungi population and the humidity tolerance of fungi. And the relationship is linear. However, due to the lack of data, we can not carry out regression analysis. We can only calculate the slope and intercept of this linear relationship by given decomposition quality. Then we add the rate to the time by day to get the total mass of the decomposition. What we need to pay attention to is that we assume that v can be expressed linearly with r and w because we refer to the results of principal component analysis in the references. And v is an important and critical value.

We construct the following equation:

$$\sum_{i=0}^{122} x_i \times a[\varphi w_x + (1 - \varphi)r_{xi}] + b = \Delta m_1$$

$$r'_{xi} = r'_1(1 - \frac{x_i}{N})$$

$$\sum_{i=0}^{122} y_i \times a[\varphi w_y + (1 - \varphi)r_{yi}] + b = \Delta m_2$$

$$r'_{yi} = r'_2(1 - \frac{y_i}{N})$$

Here, we set the weights to 0.1 and 0.9, because we observe the results of the principal component analysis method of the references, and we get that the influence of r is much greater than w .

2.3 To solve the model

Through iterative algorithm and programming calculation, we got that $a = 0.1168, b = -0.001$

3. Conclusion

In this article, the work done by our team is as follows:

- Collect credible data on fungi traits and climate indicators.
- Classify and discuss fungi according to growth rate and environmental tolerance, and construct fungal decomposition models.
- Building a competitive model to consider the interaction between different types of fungi.
- Take short-term fluctuations of weather indicators and long-term climate changes into consideration. And we change the types of fungi in the model to explore the impact of biodiversity
- Analyze the accuracy and sensitivity of our model.
- Write an article for the introductory college level biology textbook.

References

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