

东北地区林参复合经营土壤质量变化研究

Research on Soil Quality Variation of Forest-Ginseng System in Northeast China

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汇报提纲 Outline

1. 绪论 Introduction

2. 研究区概况和方法 Study area and method

3. 研究结果 Results

4. 结论与展望 Conclusion and progress

1.1 Background

1

As one of the ancient and multiple benefits of land use, **agroforestry** has been widely adopted by the whole world.

2

During the process of deepen forestry reform and transform of forestry development mode, **under-forestry economy** has been considered as an effective way.

3

The **forest-ginseng system** is one of the typical under-forestry economic modes in the northeast of China.

4

Soil quality is still an important factor restricting the development of ginseng cultivation.

1.2 Research progress

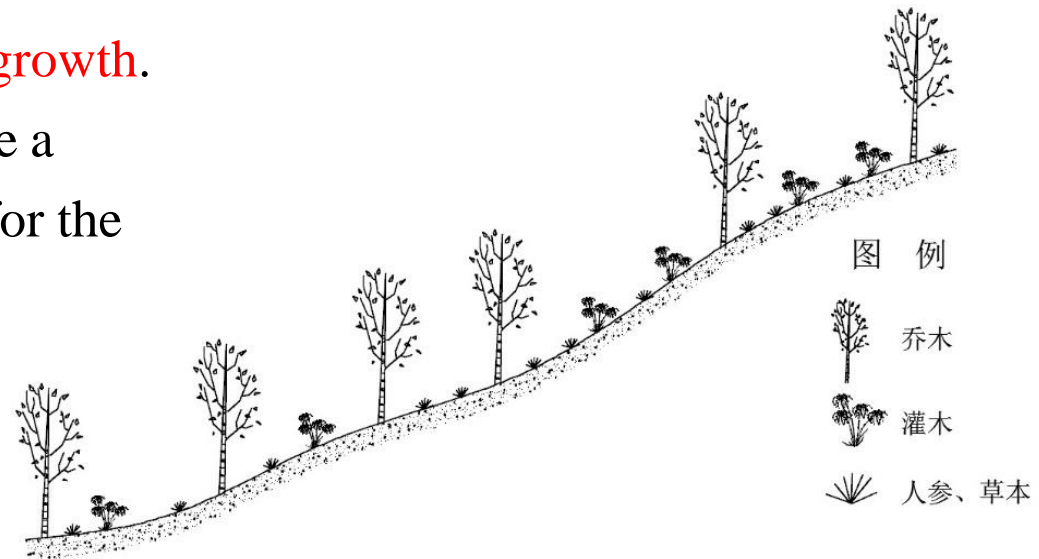
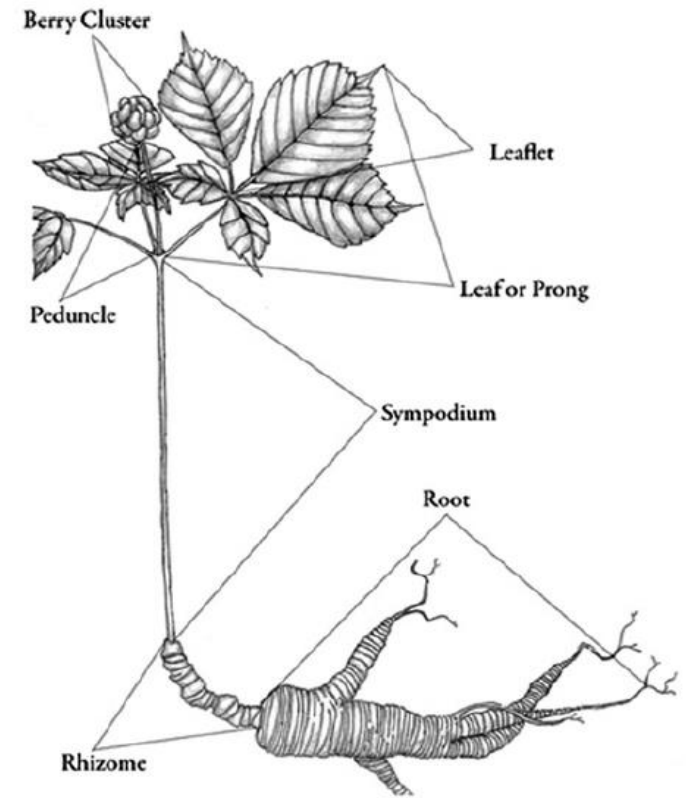
- The mode of **ginseng cultivated under forest** is still scarce in the world.
- In view of the precious medicinal value of ginseng, research on its **pharmacology** has been studied in detail. Especially the Journal of Ginseng Research.
- Currently, disseminated and physiological diseases, continuous cropping obstacles, are still not well resolved in ginseng cultivation.



Ginseng is a perennial herb, belongs to *Araliaceae Panax*, known as the “northeast Sanbao”.

Ginseng pays attention to five - shaped, which is **root, rhizome, skin, grain, and body**.

Forest-ginseng system is a mode of ginseng cultivation, which ginseng seed is sow by human under the forests according to the different sow patterns, **with natural growth**. Meanwhile, arbor vegetation provide a suitable microclimate environment for the growth of ginseng.



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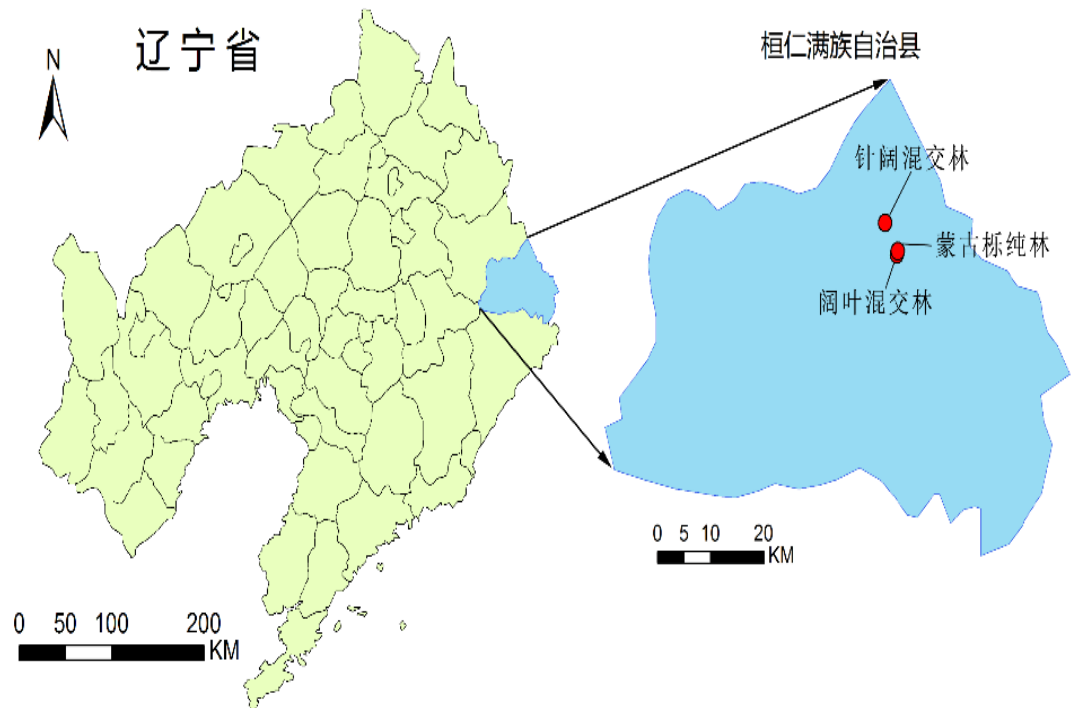
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2.1 Study area

Location: The study area is located in Huanren Manchu Autonomous County of eastern Liaoning Province, Northeast China, which belongs to the southeast continuation of the Changbai Mountain range. The location is $124^{\circ} 27'$ - $125^{\circ} 40'$ east longitudes, $40^{\circ} 54'$ - $41^{\circ} 32'$ north latitudes.

Climate and soil: The study area has a humid mid-temperate climate with strong continental monsoon features including four distinct seasons. The mean annual air temperature is 6°C - 8°C , and annual precipitation ranges is 800 - 1000 mm. The parent material is granite bedrock and the soil is Haplumbrepts.



2.2 Plot characteristics

Currently, **broad-leaved mixed forest (BM)**, **conifer and broad-leaved mixed forest (CB)**, and **Quercus mongolica forest (QM)** are widely distributed forest-ginseng agroforestry stand types.

Forest types	Slope	Aspect(°)	Slope(°)	Alt. (m)	WPD (trees/hm ²)	DBH(cm)	Height(m)	Plant coverage
BM	Upper	East	24	442	765	17.37	18.64	0.75
CB	Middle	Northeast26	20	534	585	20.82	19.85	0.70
QM	Upper	East	20	529	495	24.26	22.55	0.70



2.3 Soil sampling

BM

3 year
6 year
9 year
12 year
Non-cultivated

CB

14 year
Non-cultivated

QM

20 year
Non-cultivated

We randomly selected three pieces of ginseng at a certain distance in the three kinds of forest types with different ages of ginseng. Then, we collected the surrounding soil of ginseng roots along the growth direction. Part of soil stored in the -4 C portable refrigerator for soil microbial and soil enzyme determination, part of soil stored in the normal temperature preservation for soil nutrient determination, and 100cm³ ring knife used to collect soil for the determination of soil physical properties. In addition, we collected the non-cultivated ginseng soil in the three kinds of forest types, and the depth of soil sampling is similar to the depth of ginseng growth.



2.4 Soil analysis

In this study, physical, chemical, and biological indicators were measured to reveal the variation characteristics of soil quality in forest-ginseng system.

	Indicators
Physical properties	BD(Bulk density)、BP(Bulk porosity)、NCP(Non-capillary porosity)、MMC(Maximum moisture capacity)
Chemical properties	pH、OM(Organic matter)、TN(Total N)、TP(Total P)、AP(Available P)、TK(Total K)、AK(Available K)
Microbial activity	MBC(Microbial biomass carbon)、MBN(Microbial biomass nitrogen)
Soil enzyme activities	POD(Peroxidase)、 β G(β -1, 4-glucosidase)、NAG(β -1, 4-N-acetylglucosaminidase)、AP(acid phosphatase)
Soil microorganism	B(Bacteria)、F(Fungi)、A(Actinomycetes)

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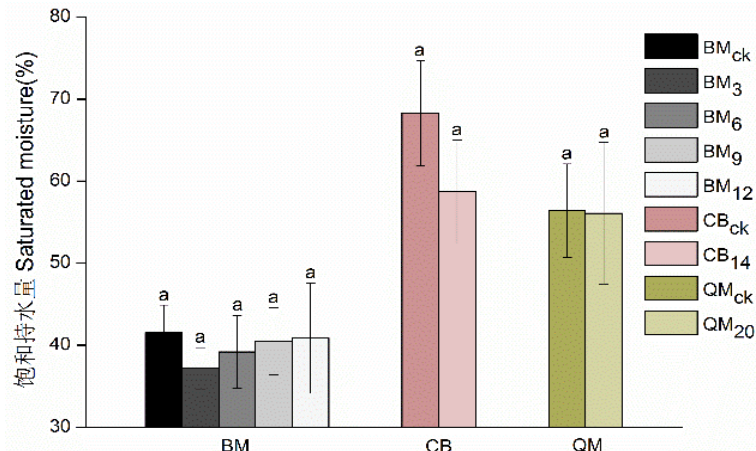
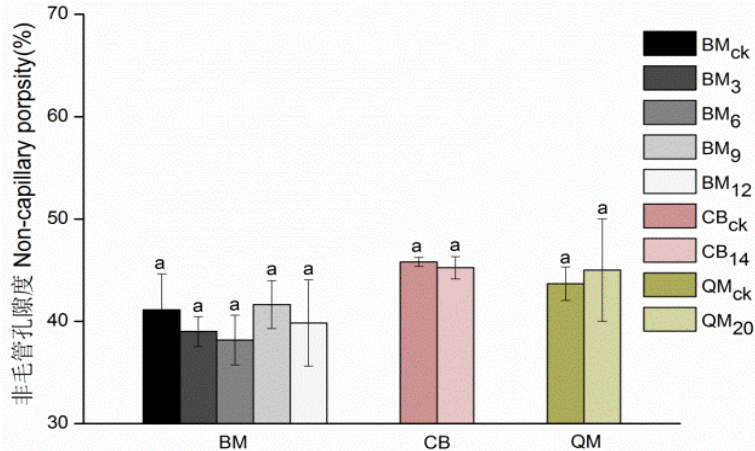
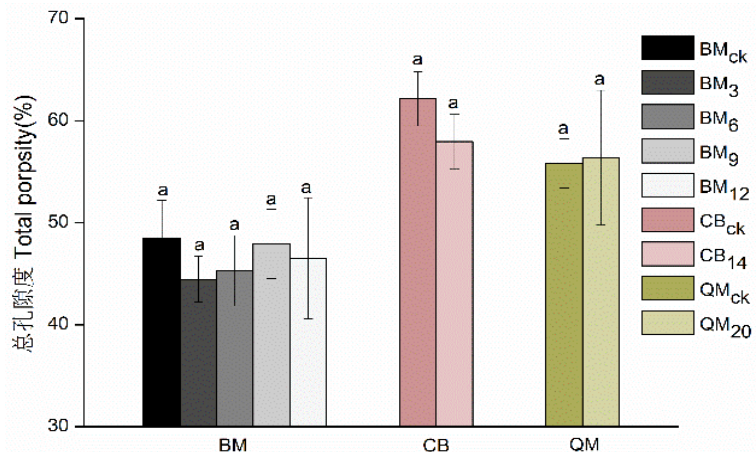
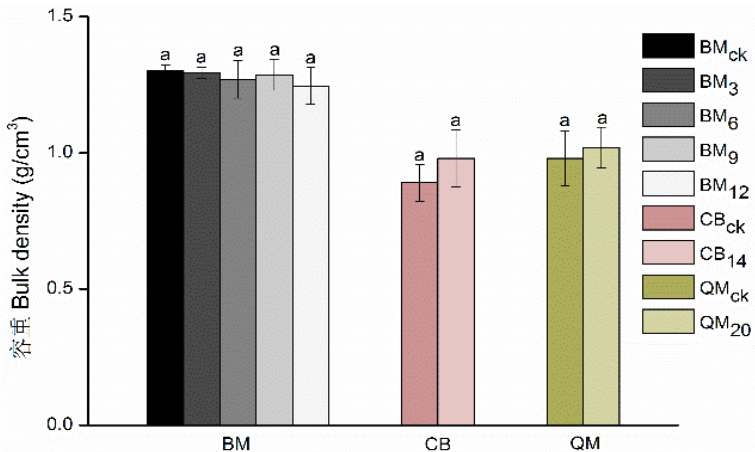
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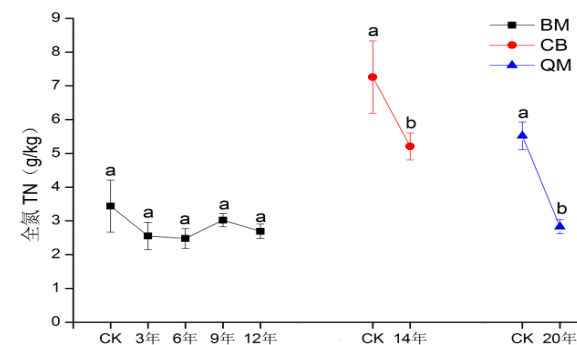
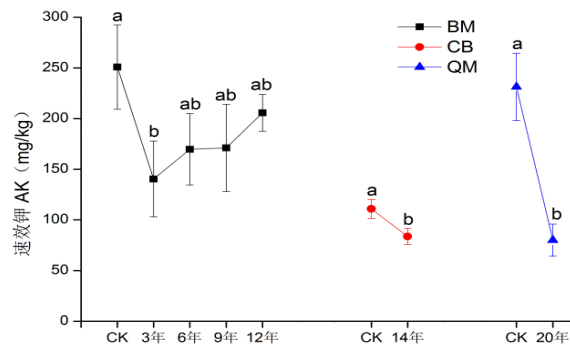
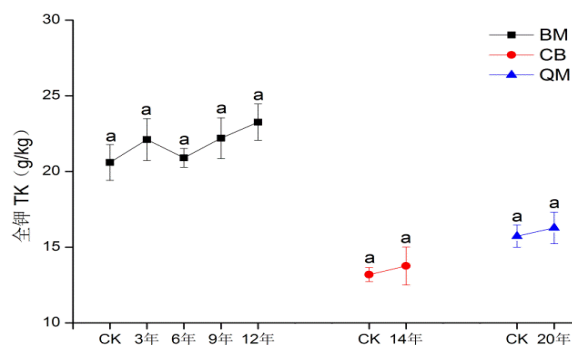
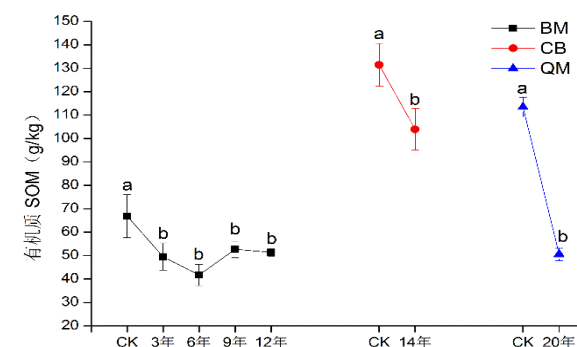
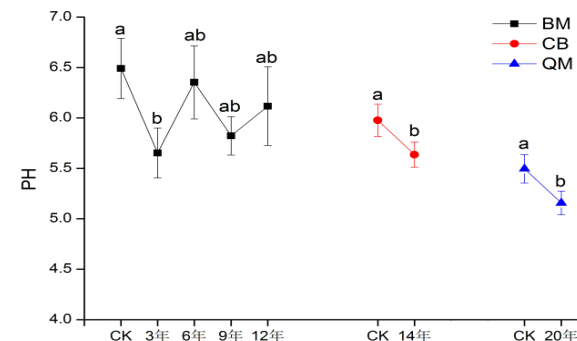
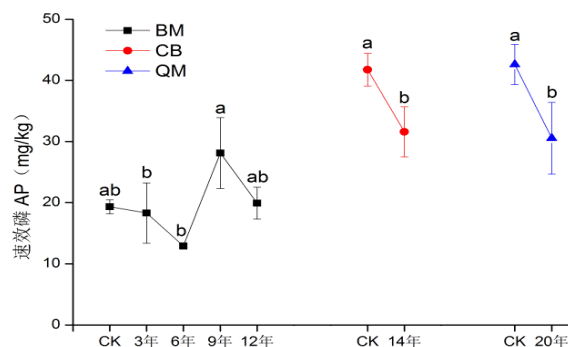
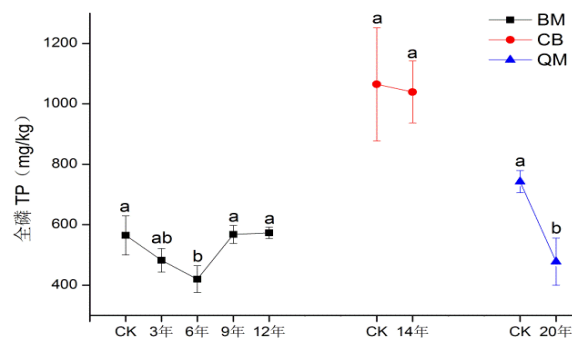
3.1 Physical properties

In terms of physical properties, ginseng cultivation with different ages has **no obvious difference**.



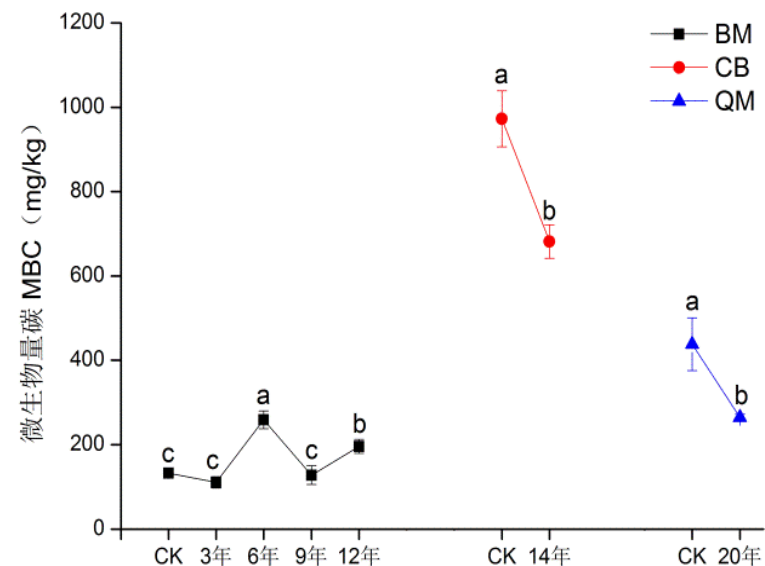
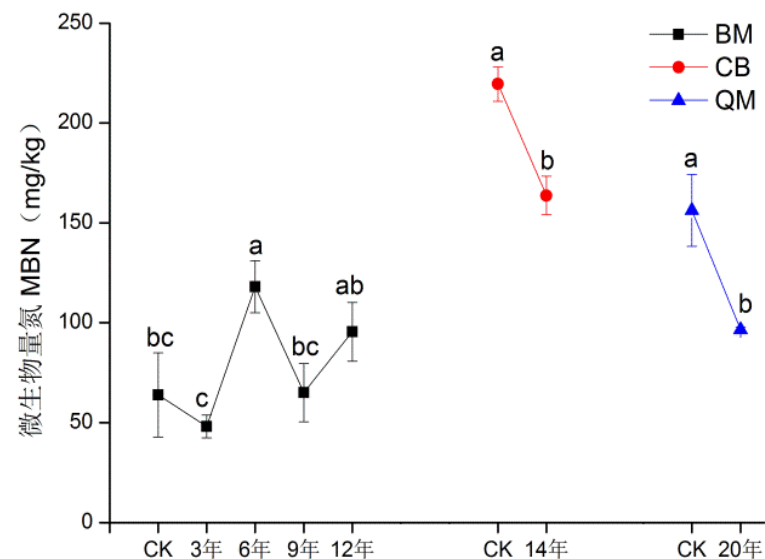
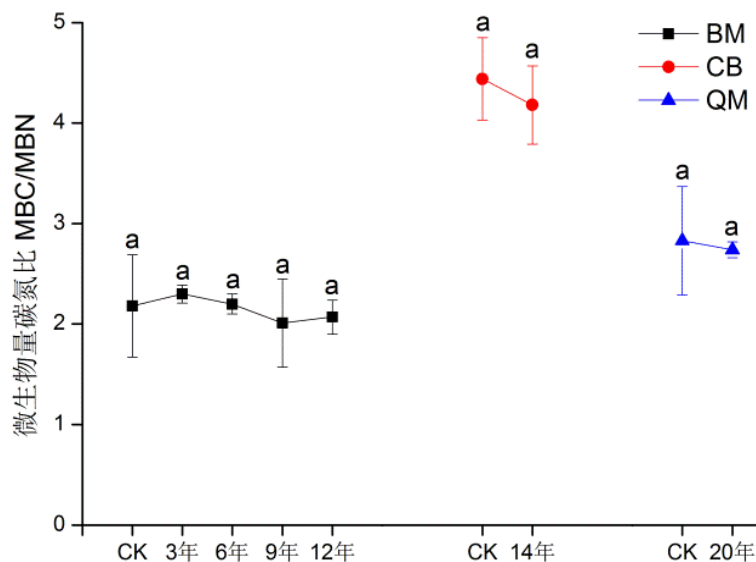
3.2 Chemical properties

In terms of nutrients, in addition to total K, the other nutrients show a downtrend of fluctuation from 3 to 12 years in BM, and 6 year ginseng soil is an obvious turning point; however, the other nutrients decreased significantly in CB and QM.



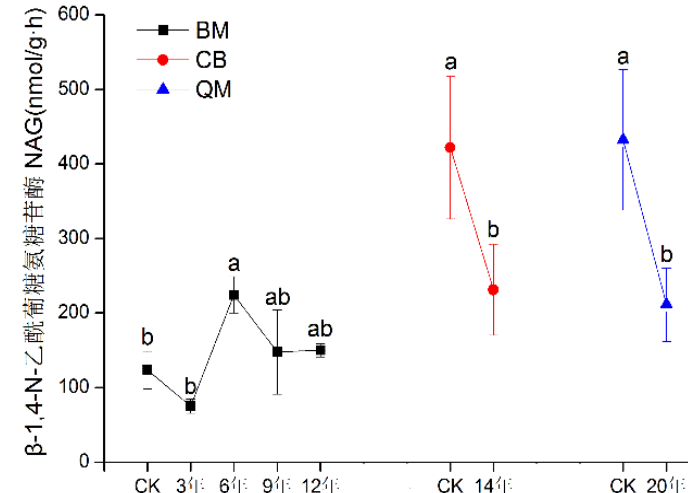
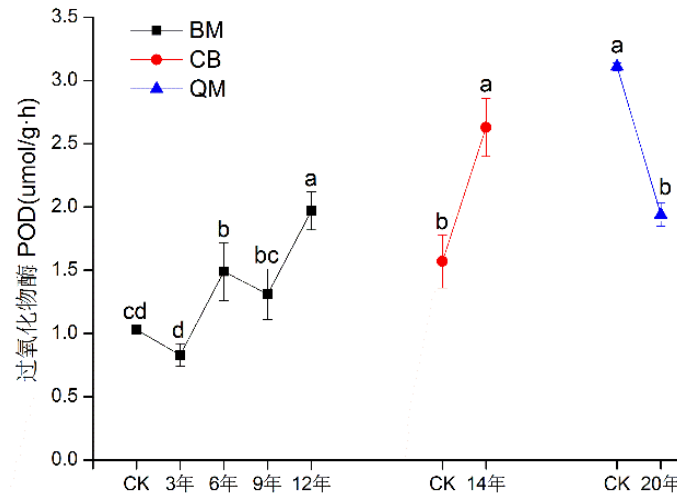
3.3 Microbial activity

In terms of microbial biomass, microbial biomass C and N show a fluctuation from 3 to 12 years, and microbial biomass C and N contents are the highest in 6 year ginseng soil; in CB and QM, the microbial biomass C and N contents decrease significantly in 14 year ginseng and in 20 year ginseng separately.

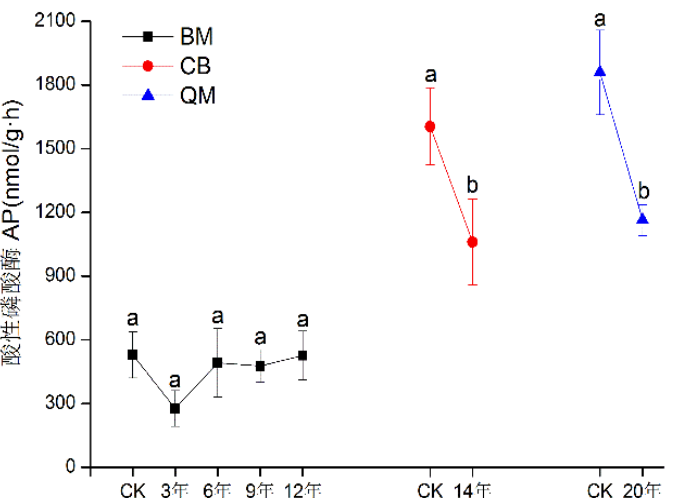
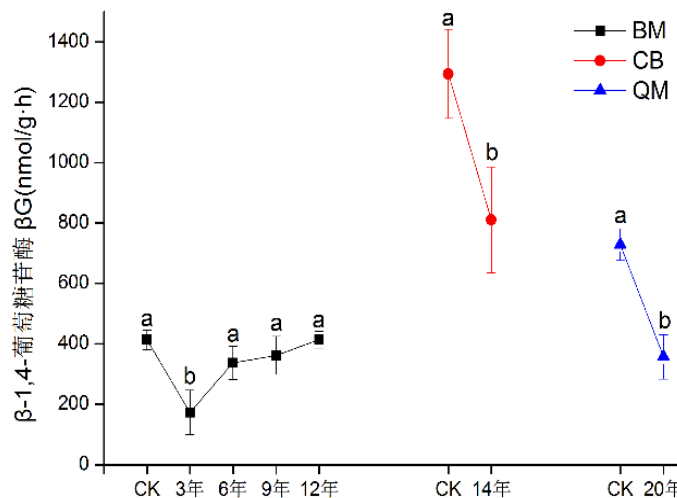


3.4 Soil enzyme activities

In terms of enzyme activity, in BM, **POD** presents an upward trend of fluctuation; **NAG** drops to the lowest in 3 year, then rises to the highest in 6 year, thereafter decreases a little until 12 year; **β G** and **AP** also drop to the lowest in 3 year, then rise to the highest in 6 year, thereafter remain stable until 12 year.



In CB, **NAG**, **β G** and **AP** in 14 year ginseng decrease significantly, but **POD** increases significantly.



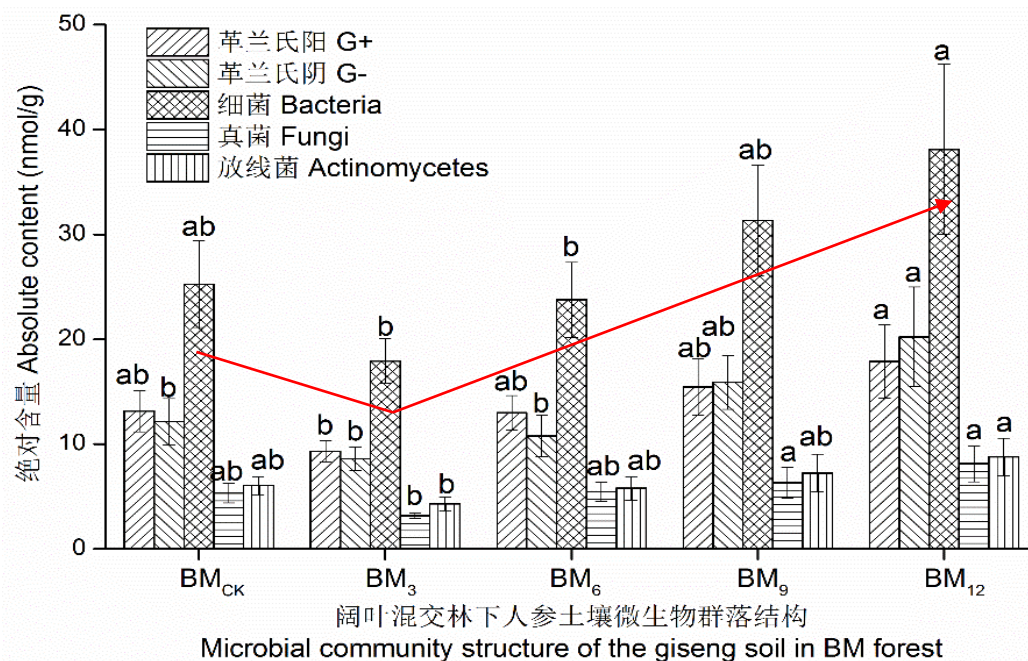
In QM, **all the enzymes** have a significant drop.

3.5 Soil microorganism

In BM, the microbial quantity and species present fluctuating changes; soil microbial community and diversity also show fluctuating changes. but the difference is **not significant** compared with non-cultivated ginseng soil.

In addition, **6 year ginseng** is a turn point.

3.5.1 BM（阔叶混交林）

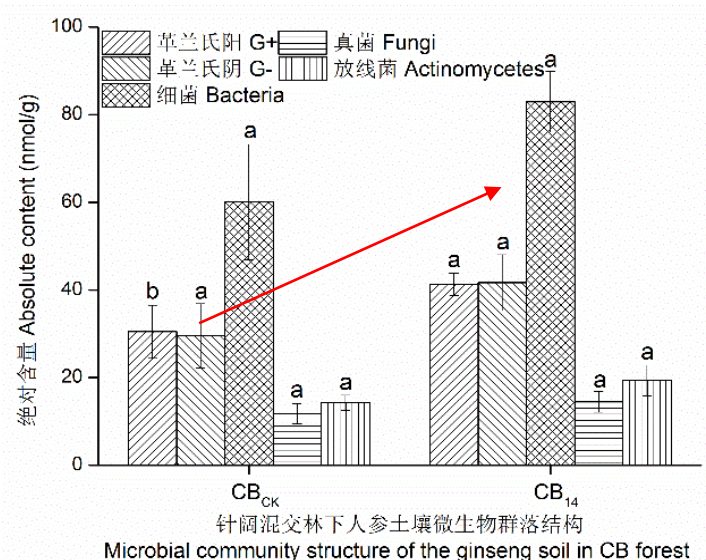


处理	多样性指数 (H')	均匀度指数 (J)	丰富度指数 (R)
BM _{CK}	3.12±0.05a	0.91±0.01ab	2.68±0.09a
BM ₃	3.17±0.08a	0.91±0.01ab	2.89±0.27a
BM ₆	3.21±0.03a	0.92±0.01a	2.88±0.17a
BM ₉	3.03±0.12a	0.88±0.02b	2.75±0.11a
BM ₁₂	3.14±0.03a	0.89±0.02ab	2.87±0.24a

处理	Microbial community structure			
	G+/G-	A/B	A/F	F/B
BM _{CK}	1.0869	0.2402	1.1505	0.2122
BM ₃	1.0852	0.2397	1.3571	0.1767
BM ₆	1.2170	0.2427	1.0589	0.2294
BM ₉	0.9708	0.2291	1.1443	0.2006
BM ₁₂	0.8891	0.2303	1.0800	0.2133

3.5.2 CB（针阔混交林）

In CB, compared with the non-cultivated ginseng soil, the microbial quantity and species of 14 year ginseng soil has no obvious changes, soil microbial biomass has a increase, but not significantly; soil microbial community and diversity also have no obvious changes, which may indicate that the microbial community is stable and the soil environment is still in the state of being suitable for the growth of ginseng based on the state of ginseng.

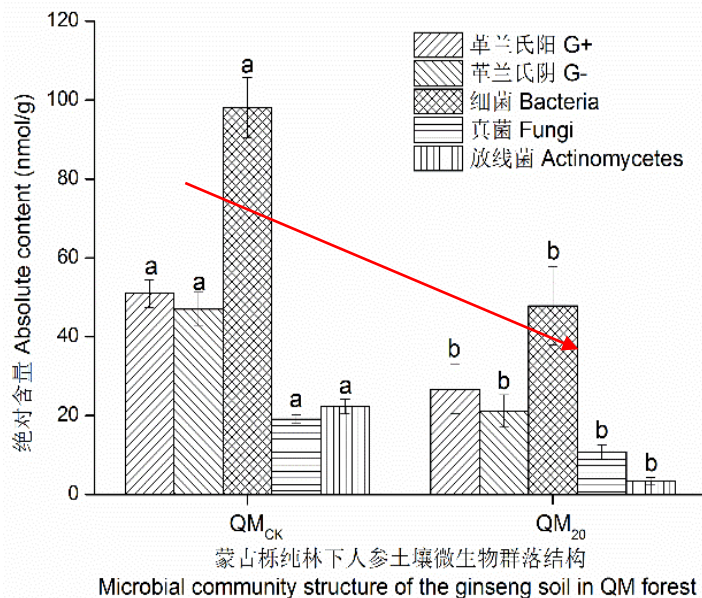


处理	Microbial community structure			
	G+/G-	放线菌/细菌	放线菌/真菌	真菌/细菌
CB _{CK}	1.0382	0.2421	1.2227	0.1980
CB ₁₄	1.0049	0.2315	1.3330	0.1735

处理	多样性指数 (H')	均匀度指数 (J)	丰富度指数 (R)
CB _{CK}	3.32±0.02a	0.91±0.01a	3.17±0.16a
CB ₁₄	3.30±0.04a	0.89±0.02a	3.22±0.13a

3.5.3 QB（蒙古栎纯林）

In QM, compared with the non-cultivated ginseng soil, the microbial quantity and species of 20 year ginseng soil has obvious reduction; soil microbial biomass decreases significantly; the proportion of actinomycetes decreases significantly, the proportion of fungi、G+/G- and evenness index have a increase, which may indicate that the microbial flora tends to be stable equilibrium state.



处理	Microbial community structure			
	G+/G-	A/B	A/F	F/B
QM _{CK}	1.0873	0.2273	1.1639	0.1954
QM ₂₀	1.2550	0.0715	0.3185	0.2254

处理	多样性指数 (H')	均匀度指数 (J)	丰富度指数 (R)
QM _{CK}	3.31±0.06a	0.90±0.01b	3.21±0.10a
QM ₂₀	3.30±0.01a	0.92±0.00a	3.01±0.05b

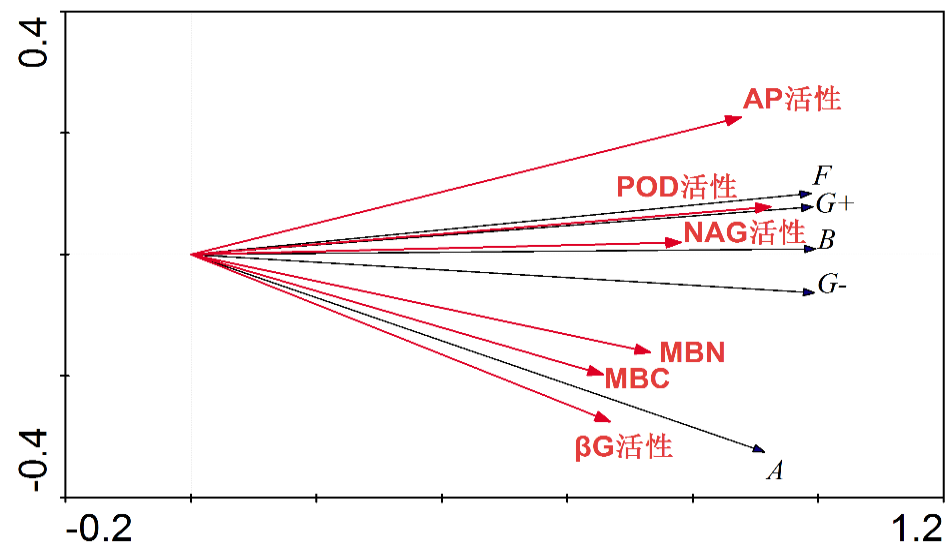
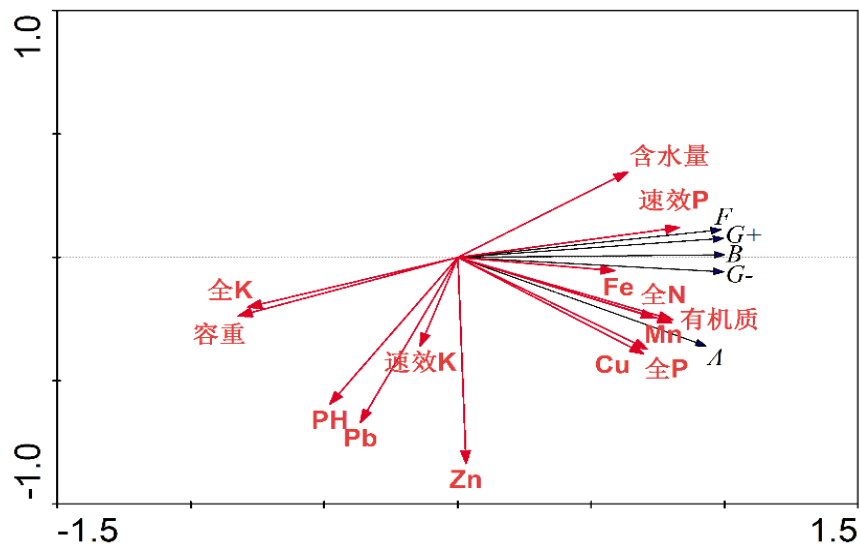
3.2.3 Influence of environmental factors

Microbial biomass has a **negative correlation** with bulk density and pH, and a **positive correlation** with nutrients and enzymes.

In the physical and chemical factors, **AP**、**TN**、**OM**、**T Mn** have a larger impact on the microbial community, but **T Zn**、**T Fe**、**AK** have a low impact.

In the biological factors, **AP**、**POD**、**NAG** have a great influence on B、F, and **MBC**、**MBN**、 **β G** have a great influence on A.

In addition, four kinds of soil enzymes and microbial activities have **positive effect** on the microbial community.



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Conclusions

The study concludes that 6 year is a turning point during the growth of ginseng that the growth is very active at this time, 14 year may be another turning point that the growth begin to slow down obviously at this time, and 20 year has been basically stable.

The characteristics of forest stand types and ginseng cultivation years had different influences on soil quality. From the perspective of stand types, the suitable degree of ginseng cultivation decrease in order of CB, QM and BM. From the perspective of ages, the soil quality decreases gradually with the increase of ginseng cultivation age.

However, the soil quality value present a fluctuation in BM, which may be related to the variable activity of ginseng growth in 12 years, and the poor stand site of BM influencing the ginseng growth that indirectly influence the variation of soil quality in return.

Deficiency

- At present, the planting of ginseng under forest is a piece of land. It is very difficult to find the similar site characteristics with different age of ginseng. In addition, Farmers are excluded from soil sampling in ginseng yard.
- The lack of analysis on the quality of ginseng and other aspects for the different types.

Expectation

- Actively establish forest-ginseng system operation of production and research base, strengthen the monitoring and evaluation of ginseng soil in different conditions.
- Strengthen the soil quality management of forest-ginseng system.
- Actively adopt molecular biology and other biological technologies to strengthen the experimental research on soil microorganisms.

A photograph of a forest floor with green plants and red berries. A large tree trunk is on the left. The text '谢谢!' is overlaid in the center.

谢谢！

Thanks !