Effect of freezing and thawing on nutrient content of soft rock

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Abstract. There are few studies on the effects of freeze-thaw on soil nutrients and soil enzymes, which are directly related to soil fertility and soil biological activity. In the past, the research mainly focused on the nitrogen and phosphorus cycle in the growing period of soil, but more and more studies have found that the non growing season in winter and the change of snow cover thickness caused by global warming affect the nitrogen and phosphorus cycle in the soil. The influence of environment on the interannual scale can not be ignored. After the freeze-thaw cycle, the total nitrogen content of the soil did not change significantly, compared with that before the freeze-thaw cycle, the available potassium content of the arsenic sandstone increased, but not significantly; the available phosphorus content of the soil in the freeze-thaw cycle decreased.

1. Introduction
The long-term ecosystem monitoring shows that the impact of cold winter and frequent freezing and thawing on the ecosystem will continue to the subsequent growth season [1-2]. This effect is closely related to soil properties, microbial activity and community structure, climate conditions, vegetation composition and management methods [3-5]. However, due to the differences in research methods and methods, many research results about freeze-thaw effect on soil nitrogen and phosphorus cycle are quite different [6-7].

2. Materials and methods

2.1. Natural condition of test site
According to the characteristics of soil zonal distribution in Shaanxi Province, the soil in this experiment is from two soil types, namely, aeolian sand soil in Hengshan District of Yulin City. The retrieved soil samples were treated immediately and 1 kg was taken for nutrient content determination as control data [8].
2.2. Test material
For the long-term frozen soil treatment, take 20 kg of fresh soil samples from each layer, divide them into 4 parts, and freeze them at -10 °C, -20 °C, -30 °C, respectively, 0.5h, 1H, 2h, 4h, 7h, 11h, 16h, 22h, observe and record the frozen state of soil samples. On the 30th, 60th and 90th day, 1kg of each soil sample was taken and melted at 5 °C, 10 °C, 15 °C and 20 °C respectively. When it melted for 0.5h, 1H, 2h, 4h, 7h, 11h, 16h and 22h, the melting state of soil sample was observed and recorded. The nutrient content was measured after melting for 24 hours [9].

For each layer of fresh soil sample, 20 kg was taken and divided into 4 parts, respectively frozen at -10 °C, -20 °C, -30 °C, frozen for 0.5h, 1H, 2h, 4h, 7h, 11h, 16h and 22h, and the frozen state of soil sample was observed and recorded. Freeze for 15 days, take out and melt at 5 °C, 10 °C, 15 °C and 20 °C respectively, and observe and record the melting state of soil samples when melting for 0.5h, 1H, 2h, 4h, 7h, 11h, 16h and 22h. The thawing period is 15 days. At the end of the first, second and third cycles, 1kg of each soil sample was taken to determine its nutrient content [10].

2.3. Data Statistical Method
All the test data are plotted by Microsoft Excel 2003 software.

3. Results and analysis
From Fig. 1, under the condition of no treatment or room temperature, the total nitrogen content of arsenic sandstone soil sample did not change obviously, the lowest value was 0.08 g / kg in the eighth month, and the highest value was 0.14 g / kg in the sixteenth month. Under the alternative freezing and thawing treatment, the total nitrogen content of arsenic sandstone soil samples showed a decreasing and increasing trend, with a small range of changes, which were 0.08 g / kg in the lowest August and 0.14 g / kg in the highest February, respectively. Under long-term freezing treatment, the change of total nitrogen content of arsenic sandstone soil samples showed an increasing trend, with a small range, which was 0.08 g / kg in the fourteenth month of the lowest value and 0.15 g / kg in the tenth month of the highest value.

![Figure 1. Change trend of total nitrogen content of arsenic sandstone under different treatments](image-url)

From Fig. 2, under the condition of room temperature, the content of available phosphorus in the soft rock soil samples changed obviously, the lowest value was 1.7 mg / kg in the eighth month, and the highest value was 3.0 mg / kg in the fourteenth month. Under the alternative treatment of freezing and thawing, the change of available phosphorus content of arsenic sandstone soil samples showed an increasing trend, which was 1.5mg/kg in the 16th month and 2.9mg/kg in the 14th month, respectively.
Under long-term freezing treatment, the change of available phosphorus content of arsenic sandstone soil samples showed a decreasing trend, which was 1.8mg/kg in the lowest value in the 16th month and 3.5mg/kg in the highest value in the 12th month.

![Graph showing the variation trend of available phosphorus content in arsenic sandstone under different treatments](image)

**Figure 2.** Variation trend of available phosphorus content in arsenic sandstone under different treatments

From Fig. 3, under the condition of no treatment or room temperature, the content of available potassium in the soft rock soil sample changed little, the lowest value was 44 mg / kg in the 16th month, and the highest value was 55 mg / kg in the 4th month. Under the alternative treatment of freezing and thawing, the content of available potassium in the soft rock soil samples changed slowly, which was 43 mg / kg in the fourteenth month and 54 mg / kg in the twelfth month, respectively. Under the long-term freezing treatment, the content of available potassium in the soft rock soil sample changes gently, which are 40mg / kg in the lowest value in December and 68mg / kg in the highest value in April.

![Graph showing the variation trend of available potassium content in arsenolite under different treatments](image)

**Figure 3.** Variation trend of available potassium content in arsenolite under different treatments

4. **Conclusion**

The effect of alternative freeze-thaw cycle and long-term freeze-thaw on soil nutrient activation is basically the same. They only have different degrees of promoting or inhibiting effects, and have positive effects on the activation of nitrogen, phosphorus and potassium nutrients in the soil. It can
promote the nitrogen and potassium nutrients in sandstone soil, but inhibit the activation of phosphorus nutrients.

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