Research on the diversity of *Mentha dahurica* Fisch. ex Benth. of the Xiaoxing'an Mountains area in Heilongjiang province

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Abstract. The purpose of this study was to investigate the current status and distribution of *Mentha dahurica* Fisch. ex Benth. resources in Xiaoxing'an Mountains area, and to provide reference for the rational development and protection of *Mentha dahurica*. The collection and identification of *Mentha dahurica* in Xiaoxing'an Mountains area were carried out based on field investigation and literature review. 30 species of *Mentha dahurica* in Xiaoxing'an Mountains area were obtained, and 65 trees were initially identified. *Mentha dahurica* in Xiaoxing'an Mountains area mostly distribute in grassland and shrub, followed by broad-leaved forest, while *Mentha dahurica* are relatively rare in mixed forest and coniferous forest. *Mentha dahurica* in Xiaoxing'an Mountains area are rich in resources and have good prospects for development and application.

1. Introduction

*Mentha dahurica* Fisch. ex Benth. is one of the six kinds of wild peppermint K in China[1]. There are about 30 kinds of *Mentha* L. in the Plant kingdom[2]. They widely distribute in the temperate regions of the northern hemisphere. There are 12 species in China, and 6 of them are wild *Mentha dahurica*[3]. By investigating the distribution characteristics, associated characteristics, community types and biological yields of wild *Mentha dahurica* resources in Heilongjiang Province, it can provide a basis for the development of wild *Mentha dahurica* resources conservation and sustainable utilization measures[4]. The Xiaoxing'an Mountains area in the northeast are rich in vegetation, the forest is dark and humid, the soil is moist, and the soil is loose and fertile. These lead to *Mentha dahurica* widely distributed in this area[5]. Through the field investigation of wild *Mentha dahurica* in Xiaoxing'an Mountains area, it is expected to supplement the wild *Mentha dahurica* diversity database and wild *Mentha dahurica* resource development. *Mentha dahurica* are located in Heilongjiang province, Jilin province and other areas, and are mostly distributed in the Xiaoxing'an Mountains area, growing in the humid, ventilated environment, semi-shade and waterside environment of the meadow[6]. This study provides a basis for the development of wild *Mentha dahurica* resource conservation and sustainable use measures. Therefore, the investigation of *Mentha dahurica*'s resources can enrich China’s wild plant database, and the further extracts of its extracts for pathogens and crop diseases are conducive to the development and industrialization of crops.
2. Research areas and research methods

2.1. Overview of the study area
The Xiaoxing'an Mountains area is located in Heilongjiang Province, China, and the northwest-southeast mountain range. It is about 450 km long from north to south, 210 km wide from east to west, and covers an area of $7.7 \times 10^5 \text{ km}^2$. There are many terraces and wide valleys in the north of Xiaoxing'an Mountains. Low mountains and hills in the middle, the south belongs to low mountains and the mountains are steep, but the slopes are gentle and the valleys are wide. Its annual average precipitation is 500mm, and the temperature gradually decreases from south to north. Since the plant growth period is longer than that of the Daxing'an Mountains area, it can reach about 120 days per year, so there are relatively many plant species here. The Xiaoxing'an Mountains area is rich in natural resources and complex and diverse in vegetation types. It is a representative temperate primitive Korean pine needle-leaved mixed forest belt in northeast China and Asia.

2.2. Investigation and collection
Surveys were conducted using a dotted line random survey and a key area sampling survey method. Since the growth of *Mentha dahurica* are closely related to sunlight and humidity, the survey time was sampled between June and October of 2017-2018 in sunny, near-water sources and wet soil. The collection was carried out according to the low to high level, such as grass layer, leaf layer, fallen wood, standing tree and so on. After *Mentha dahurica* was explored, it was numbered and photographed to record the habitat and ecology of *Mentha dahurica*. After this, it is collected, and the integrity of the specimen is maintained during the collection.

2.3. Identification of specimens
The *Mentha dahurica* were identified not only according to the main characteristics of collected peppermint, but also combine habitats, ecology and other living habits. The collected specimens were identified by consulting the Chinese plant species information database and classification monographs. "Higher Plants of China in Colour", "Chinese Flora", "Northeast Plant Retrieval Table" and "Heilongjiang Flora". Specimens and photo materials have been kept in the Microbiology Laboratory of Jiamusi University.

3. Results and analysis

3.1. Unit area of Mentha dahurica in Xiaoxing' an Mountains area
In this study, there were 203 samples of *Mentha dahurica* were collected. With the combination of literature and field investigations, the unit area of the wild *Mentha dahurica* resources in the area was statistically investigated. Using sample method survey, randomly sampled 42 plots (100m$^2$), sampled the samples in each sample and dug the sample, measured the weight of the individual plants after shady drying and calculated the yield by the sample method. The formula is as follows[7]:

$$W = X \times Y$$  \hspace{1cm} (1)

In with: $X$ is means the average number of plants in the sample, and $Y$ is means the average weight of the individual herbs.

The average unit area of the survey area in Xiaoxing'an Mountains area was 11.23g/m$^2$.

According to the combination of literature reports and field trips, *Mentha dahurica* distribute in Jiamusi City, Yichun City, Nancha District, Jinshantun District, Dailing District, Wuying District and Hongxing District. 42 plots were set up in 7 areas in Xiaoxing'an Mountains area (As shown in Table 1). Six plots of 10m × 10m were sampled in each plot, for a total of 42 survey samples. At the same time, the individual wild *Mentha dahurica* appearing in the plot also collected, and the amount of the medicinal material was estimated.
Table 1. The establishment of sample quadrates for field survey

| Plot type            | Number of plots | Sample tree (strain) | Average quality of individual medicinal materials (g) |
|----------------------|-----------------|----------------------|-----------------------------------------------------|
| shrub                | 21              | 90                   | 17.23                                               |
| Coniferous forest    | 11              | 43                   | 17.51                                               |
| Mixed forest         | 10              | 37                   | 17.36                                               |
| Broadleaf forest     | 5               | 22                   | 16.71                                               |
| Grassland            | 3               | 11                   | 16.92                                               |

3.2. *Mentha dahurica* ecological environment and community type shrubs

According to the set plots, the community structure, renewal succession and community hierarchy of each population were investigated and analyzed. The investigation found that *Mentha dahurica* are a kind of heliophile, they mostly distribute in the wet, fertile, sunny bushes, the junction of cultivated land and broad-leaved forest. In the ecological environment of coniferous and broad-leaved mixed forests, broad-leaved forests, shrubs, coniferous forest margins and cultivated land, there are distribution of wild *Mentha dahurica*. Among them, the arbor layer is dominated by *Betula platyphylla*, *Fraxinus mandshurica*, *Tilia amurensis*, *Acer pseudo-sieboldianum*, *Xylosma racemosum*, *Acer mono*, *Pinus koraiensis*, *Crataegus pinnatifida var. major*, *Ulmus pumila*, *Acer ginnala*. The shrub layer is dominated by *Philadelphus incanus*, *Corylus heterophylla*, *Rhamnus davurica*, *Syringa reticulata var. amurensis*, *Aralia mandshurica*, *Lonicera amurensis*, *Ac-anthopanax senticosus*. The herbaceous layer is dominated by *Meehania urticifolia*, *Carex callitri-chos*, *Rabdosia excise*, *Dryopteriscrassirhizoma*, *Equisetumhyemale*, *Adiantum pedatum*, *Phryma leptostachyasubsp. Asiatica*. According to investigations, *Mentha dahurica* prefer to grow in sunny and humid land such as the border between forest edge and field or waterside.

3.3. Distribution of different forest types of *Mentha dahurica* in Xiaoxing'an Mountains area

From the vegetation types (broad-leaved forests, mixed forests, coniferous forests, grasslands, shrubs) distributed by *Mentha dahurica*, statistics show that the *Mentha dahurica* in the Xiaoxing'an Mountains area are mostly distributed in shrubs, broad-leaved forests and mixed forests, Less in coniferous forests and grasslands. Among them, the number of shrubs is the largest, with 50 plots, accounting for 44.3% of the total; 15 plots are distributed in broad-leaved forests, accounting for 21.52% of the total; 15 plots are distributed in coniferous forests, accounting for the total 10.5%; there are 12 plots distributed in mixed forests, accounting for 5.32% of the total. As shown in Figure 1.

![Figure 1. Ecological distribution of *Mentha dahurica* in different forest types.](image-url)
4. Discussion and conclusion
The Xiaoxing'an Mountains area belongs to the primary and secondary coniferous forests, which provides a good environment for the growth of Mentha dahurica. The soil moisture and light intensity in different forest types in Xiaoxing'an Mountains area are different, which lead to the difference in the number of Mentha dahurica growing in different forest types. The Mentha dahurica which prefer sunlight grow in low grasses and shrubs. Mentha dahurica in Xiaoxing'an Mountains area mostly distribute in forest edge grassland, followed by shrubs and coniferous forests. The number of Mentha dahurica in the above three environments are dominant, while that of broad-leaved forests and mixed forests are relatively rare. There are many Mentha dahurica grow in Xiaoxing'an Mountains area, if it can reasonably develop new antibacterial sources and be applied to the inhibition of plant pathogens, it will have application value for promoting the development of ecological balance. In addition, human activities on the development of natural resources are intensifying, leading to changes in the local ecological environment, directly affecting the distribution resources of Mentha dahurica in Xiaoxing'an Mountains area. In the process of development and construction, we should continue to use the principle of “sustainable development” and take measures to strengthen the protection of the ecological environment of the wild Mentha dahurica.

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