

## About the Korean and Japan *Broussonetia* (Moraceae)

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### 韓国と日本の楮（コウゾ）について

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It was reviewed about the three Korean *Broussonetia* species in Moraceae by morphological characters. A hybrid species, *B. kazinoki* x *B. papyrifera* has been used for making Korean traditional paper, Hanji. The hybrid species is originated from the natural hybridization of the parent species, *B. papyrifera* (L.) L'Her. ex Vent. and *B. kazinoki* Siebold. The plant has intermediate characters of the parent species in lamina size, stipule size and petiole length.

**Keywords:** *Broussonetia*, Moraceae, Korean paper Hanji

韓国と日本の楮を現地調査してその形態的特質と形質的特徴を分析している。

### Introduction

*Broussonetia*, a small genus of Moraceae occurs worldwide in temperate, subtropical, and tropical climatic zones (Chung, 2007). The genus consists of about 8 deciduous taxa (Kim *et al.*, 1992). Three taxa have been known to be distributed in Korea (Lee, 2003).

In a study on the pollen morphology of *Broussonetia* (including Section *Allaeanthus*), the *Allaeanthus* may be retained in the genus of *Broussonetia* by the similarity of pollen (Kim and Zavada, 1993). In the morphological study of Korean *Broussonetia* (Kim *et al.*, 1992), it was found that the plants widely known as *B. kazinoki* are a hybrid species, *B. kazinoki* x *B. papyrifera*. This hybrid was firstly recorded in that paper.

In this study, it was reviewed on the morphological characters of the three Korean *Broussonetia* species.

### Materials and methods

An morphological examination was carried out for the three *Broussonetia* species in Korea (Table 1).

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**Table 1.** Collection data of *Broussonetia kazinoki* x *B. papyrifera* with related taxa

| Scientific name                           | Date         | Locality                |
|-------------------------------------------|--------------|-------------------------|
| <i>Broussonetia papyrifera</i>            | May 15, 2007 | Byunsan in Korea        |
|                                           | May 8, 2007  | Kyoto in Japan          |
| <i>B. kazinoki</i> x <i>B. papyrifera</i> | May 14, 2007 | Jeonju in Korea         |
|                                           | May 7, 2007  | Kyoto in Japan          |
| <i>B. kazinoki</i>                        | May 14, 2007 | Mt. Naejangsan in Korea |
|                                           | May 6, 2007  | Nara in Japan           |
|                                           | May 8, 2007  | Kyoto in Japan          |

## Results

### 1. Morphological study

Comparative morphological characters of 3 Korean *Broussonetia* species are shown in the following sentences.

- 1) Leaf: The leaf of *B. kazinoki* x *B. papyrifera* have the intermediate size of *B. papyrifera* and *B. kazinoki*. Leaf petiole and stipule of *B. papyrifera* and *B. kazinoki* x *B. papyrifera* have more than 1 cm long, but *B. kazinoki* only less than 1 cm long.
- 2) Inflorescence: Male plants of *B. papyrifera* and *B. kazinoki* x *B. papyrifera* have cylindrical catkin inflorescence, but *B. kazinoki* have globose heads. Female plants of *B. papyrifera* (1.1-1.3cm) have more larger inflorescence diameter than *B. kazinoki* x *B. papyrifera* and *B. kazinoki*.
- 3) Flowers: Staminate flowers of 3 *Broussonetia* species have calyx tube with 4 lobes. 4 filaments of 3 species are inflexed in bud. Pistillate flowers of 3 *Broussonetia* species have filiform style with stigmatic hairs.
- 4) Fruit: Fruit of *B. papyrifera* is matured on September, but *B. kazinoki* x *B. papyrifera* and *B. kazinoki* is matured on July.

### 2. Taxonomical study

#### 1. *Broussonetia papyrifera* (L.) L'Her. ex Vent.

Trees deciduous, dioecious. Twig 0.5-0.7 cm diameter. Leaves simple, alternate; blade ovate 14-16 cm long, 9-11 cm wide; margin coarsely serrate, sometimes 3-5 lobed, more or less scabrous; petiole 3-4 cm long. Stipules ovate, free, 1.6-2.0 cm long, 1.0-1.4 cm wide. Staminate inflorescence axillary, cylindrical, 5-7 cm long, bracts lanceolate, peduncle 0.9-1.4 cm long. Pistillate inflorescences globose heads, 1.1-1.3 cm diameter, bracts clavate, 1.7-2.1 mm long. peduncle 0.4-0.9 cm long. Staminate flowers: calyx tubular, 4 lobes; stamen 4, filaments inflexed in bud. Pistillate flowers: calyx pipelike, ovary ovoid, style filiform with stigmatic hairs, 1.0-1.2 cm long. Fruit orange-red when mature, 1.7-2.0 cm diameter, stalk 0.3-0.4 cm long.

Flowering: May

Distribution: Korea, Japan, China, Taiwan, Malaysia, Laos, Myanmar, Thailand, Vietnam

Remark: This plant is cultivating in China for making traditional paper.

## 2. *Broussonetia kazinoki* x *B. papyrifera*

Small trees deciduous, dioecious. Twig 0.3-0.5 cm diameter. Leaves simple, alternate; blade ovate 10-12 cm long, 6-8 cm wide; margin coarsely serrate, sometimes 3-5 lobed, more or less scabrous; petiole 1-2 cm long. Stipules lanceolate, free, 1.1-1.5 cm long, 0.5-0.7 cm wide. Staminate inflorescence axillary, cylindrical, 2-3 cm long, bracts lanceolate, peduncle 1.5-3.0 cm long. Pistillate inflorescences globose heads, 0.6-0.9 cm diameter, bracts clavate, 1.1-1.5 mm long, peduncle 0.4-0.7 cm long. Staminate flowers: calyx tubular, 4 lobes; stamen 4, filaments inflexed in bud. Pistillate flowers: calyx pipelike, ovary ovoid, style filiform with stigmatic hairs, 0.8-1.2 cm long. Fruit orange-red when mature, 1.0-1.5 cm diameter, stalk 0.5-0.7 cm long.

Flowering: May

Distribution: Korea, Japan, China

Remark: In Korea, this plants mostly are used for making the Korean traditional paper Hanji. Also the female plant is cultivating at Kyoto in Japan for making traditional paper Kozo-shi.

## 3. *Broussonetia kazinoki* Siebold

Shrubs deciduous, monoecious. Twig 0.1-0.3 cm diameter. Leaves simple, alternate; blade ovate 7-9 cm long, 3-5 cm wide; margin coarsely serrate, sometimes 3-5 lobed, more or less scabrous; petiole 0.5-1.0 cm long. Stipules linear-lanceolate, free, 0.5-0.7 cm long, 0.1-0.3 cm wide. Staminate inflorescence axillary, globose, 0.7-0.8 cm diameter, bracts lanceolate, peduncle 0.9-1.0 cm long. Pistillate inflorescences globose heads, 0.2-0.4 cm diameter, bracts clavate, 0.7-0.9 mm long, peduncle 0.4-0.5 cm long. Staminate flowers: calyx tubular, 4 lobes; stamen 4, filaments inflexed in bud. Pistillate flowers: calyx pipelike, ovary ovoid, style filiform with stigmatic hairs, 0.5-0.8 cm long. Fruit orange-red when mature, 1.0-1.5 cm diameter, stalk 0.3-0.4 cm long.

Flowering: May

Distribution: Korea, Japan, China

Remark: This plant is cultivating at Nara in Japan for making traditional paper Kozo-shi.

## Discussion

A hybrid species, *Broussonetia kazinoki* x *B. papyrifera* is originated from the natural hybridization of the parent species, *B. papyrifera* (L.) L'Her. ex Vent. and *B. kazinoki* Siebold. The hybrid species has been used for making Korean traditional paper, Hanji. The plant has the intermediate characters of the parent species in lamina size, stipule size and petiole length. Though *B. papyrifera* (L.) L'Her. ex Vent. has more larger pistillate (more than 1 cm diameter) and staminate inflorescence (5-7 cm long) than other species, this hybrid species has pistillate inflorescence less than 1 cm diameter and staminate inflorescence 2-3 cm long. And the hybrid species is distinguished from *B. kazinoki* having petiole and stipule less than 1 cm long. But the hybrid

species is shown some similarities with *B. papyrifera* and *B. kazinoki* including the catkin inflorescence, 4 lobed calyx, 4 curved filaments, redish syncarps, and pollen morphology (Kim and Zavada, 1993). The hybrid species is distinguished from *B. papyrifera* in petiole(3-4 cm) and stipules (1.6-2.0 cm) length. This species is also distinguished from *B. kazinoki* having monoecious plants and globose staminate inflorescence.

In Korea, *Broussonetia kazinoki* x *B. papyrifera* was only used for making Korean traditional paper, Hanji. In Japan, the female plant of *Broussonetia kazinoki* x *B. papyrifera* and *B. kazinoki* has cultivated at Nara and Kyoto for making traditional paper, Kozo-shi. *Broussonetia papyrifera* has cultivated in China for making traditional paper.

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