Ramie (*Boehmeria nivea* L.)
and Ramie Breeding in China

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1. Introduction

Ramie—a hardy perennial bast fiber crops
The useful crop life ranges from 6 to 20 years
Ramie (Boehmeria nivea (L.) Gaud.), commonly known as Chinese grass, white ramie, green ramie and rhea is one of the group referred to as the bast fiber crops. Ramie is a hardy perennial which under suitable conditions can be harvested up to six times a year. As well, the useful crop life ranges from 6 to 20 years.
A large scale garden of ramie
Ramie is a member of the Urticaceae or nettle family and is a hardy perennial which produces a large number of unbranched stems from underground rhizomes. The true ramie or 'China grass' is also known as 'white ramie' and is the Chinese cultivated plant. It has large heart shaped, crenate leaves covered on the underside with white hairs that give it a silvery appearance. The stems of ramie grow to a height of 1 to 2.5 m.
pistillate flowers

staminate flowers

ramie in flowering stage
Ramie is a monoecious plant with both pistillate and staminate flowers on the same plant. Its pistillate flowers is in the upper part of plant, its staminate flowers in the middle and lower part of plant. Ramie is a short day plant. It blossoms commonly in autumn and has got ripe seeds in winter.
• Ramie is a wind-pollinated species. Pollen grains are adapted according to the method of pollination, those carried by insect often being sticky or barbed, while wind-pollinated plants generally produce smooth light pollen. Small and light pollen of ramie can be carried 1 kilometer far away at most by wind.
ramie in grain filling stage
Ramble seeds
ramie fiber product--raw fiber
ramie fiber product--degumming fiber
ramie textiles

ramie yarn.

colour ramie fabric

ramie textiles
ramie textiles

Grass cloth, as a traditional product
Propagation of ramie

It is generally propagated vegetatively, using rhizome or stem cuttings.
The biological traits of ramie

The most suitable climate for ramie is one which is warm and humid with an annual rainfall (or irrigation) of at least 1000 mm, evenly spread over the year.

Ramie is tolerant of a range of soil types. but is reported to be sensitive to waterlogging. Well established plants can tolerate moderate drought and frost but grow better where these are absent.
Ramie can tolerate low temperature in the range of $-8$ to $-10^\circ$C degrees in winter.

Ramie prefers slightly acid soil conditions with pH in the range of 5.5 to 6.5.

As productivity is high, ramie can rapidly deplete the soil of nutrients so it is therefore important to either return the plant residues to the soil or add organic or inorganic fertilizers.
yields

The dry weight of harvested stem from both tropical and temperate crops ranges from about 3.4 to 7.5 t/ha/year; a 7.5 tonne crop yields about 3,400 kg/ha/year of dry undegumming fiber.

The weight loss of raw ramie during degumming can be up to 30%.

Yield of degumming fiber of about 1,200 kg/ha/year.
yields of different region in China

- High yield and multi-purpose

**Ramie** yield for multi-purpose

<table>
<thead>
<tr>
<th>Region</th>
<th>Raw Fiber (kg/ha)</th>
<th>Tender Shoots (kg/ha)</th>
<th>Core (kg/ha)</th>
<th>Biomass (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunan</td>
<td>5,190</td>
<td>8,415</td>
<td>16,425</td>
<td>30,030</td>
</tr>
<tr>
<td>Hubei</td>
<td>5,265</td>
<td>9,645</td>
<td>13,695</td>
<td>28,605</td>
</tr>
<tr>
<td>Jiangxi</td>
<td>4,920</td>
<td>9,285</td>
<td>13,635</td>
<td>27,825</td>
</tr>
</tbody>
</table>

- Textile
- Feed
- Culture medium for mushroom
- Residues
  - More than 80% of the total biomass
  - Rich of CP and other nutrients
More feed gotten by Four cuts (Plant)

Highest yield in Hunan for the most efficient soil management (Soil)

Highest profits in Jiangxi for the lowest cost during production (Process)

• We had done researches on optimizing the farming management to gain a higher yield and profit.
New machine for ramie harvest
2. Origin and distribution area of ramie

- Ramie originated from Yungui Plateau of China.
- Chinese Boehmeria plants mainly distributed in the provinces as Yunnan, Guangxi, Guangdong, Sichuan, and Guizhou.
- The main planted counties in the world are reported to be China, Brazil, Philippines, India, South Korea, and Thailand.
Ramie originated from main area

Guizhou

Yunnan

Yangtze river
Distribution of ramie in the world
3. Ramie germplasm resources

• The National Field Genebank for Ramie was established in 2001.

• There are 2052 ramie accessions which subject to 19 species and 8 varieties collected and conserved in The National Field Genebank. Among them there are 1901 cultivar accessions and 151 wild species accessions.

• We have exchanged ramie germplasm and information with more than 20 foreign countries or regions.
National Ramie Germplasm Nursery in Changsha
full view of national ramie germplasm nursery in Changsha
4. Main methods of ramie breeding

- Cross breeding and selective breeding are the most important methods for hereditary improvement of ramie. Mostly ramie varieties are bred by crossbreeding in China. Other methods of ramie breeding is sometimes used including radiation breeding, tissue culture breeding and spaceflight breeding etc.
5. The main ramie varieties bred in recent years

- **Fiber-Zhongzhu NO.1**
- **Multi-purpose-Zhongzhu NO.3**
- **Dual-purpose-Zhongzhu NO.2**
Zhongsizhu NO.1
(released in 2005)
Huazhu NO.5
(released in 2010)
Chuanzhu NO.11
(released in 2010)
6. The relevant studies with ramie breeding

- (1) The genetic diversity of 9 main ramie varieties

Fig. 2 Dendrogram generated based on SSR markers for the nine Ramie varieties used in this study
(2) Study on Glutamine Synthetase Genes Cloning and Over-expression of Ramie

- Glutamine synthetase (GS) plays fundamental roles in higher plants nitrogen primary assimilation.
- GS isoenzymes have essential effects to the nitrogen absorption, assimilation and use efficiency.
- The focus of our study was first isolation and characterization of ramie GS gene families, and comparatively analyzed of GS gene families sequences, GS gene families expression pattern at different tissues and development stages.
• The over-expression plant vector of ramie BnGS1-2 gene was constructed according to homologous recombination technology and transgenic tobacco was obtained by “leaf-disk” transformation method.

• The investigation of the effects of BnGS1-2 over-expression in improving the nitrogen absorption, assimilation and use efficiency provided theoretical basis at molecular level for ramie GS function and nitrogen assimilation pathway, and material basis for utilization of ramie GS genes.
Thanks for your attention!