The Application of Ramie in Forage and Cultivation of Edible Fungus

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• What have we done and achieved?
• How does foreground and prospect of ramie industry?
Why should we do?

Ramie planting area

Ramie—Perennial bast fiber crops
The structure of ramie

- Ramie is one of the most important crops in China. Traditionally, it can be used as fiber or herbs crop. There are different characteristics for each body of plant.
New varieties and their application in ramie

Fiber-Zhongzhu NO.1

Dual-purpose-Zhongzhu NO.2

Multi-purpose-Zhongzhu NO.3
- Cuttage is the main planting technique for ramie with tender shoot. However, it’s an intensive-labor work and the low cost of labor is fading away gradually in China.

- Some industrial crops, like ramie, have been cultivated in hillside in order to provide more plowland to food crops in China. It is important, therefore, to study the planting mechanization of ramie further.
Meanwhile, manual decortication is another crucial problem for ramie industry.
• Handlooms are employed to produce cloth using ramie fiber for thousands of year and will be used continually for a long time in the future.
• However, handlooms can only produce the simple traditional products and this pattern of production won’t fit the marketable demands at present.
- In recent years, the ramie industry shrank in China due to the rising cost of labor and the changing idea towards job.

- Although the imports and exports of ramie is the reduction, its production keeps stable in China. It indicates that the domestic consumption is the increment.
The characteristics of ramie

• Excellent nutritional value for herbivores
  ✓ The average content of crude protein (CP) is about 21% in ramie shoots, which is 16.7% higher than in alfalfa.

• High yield and fast growing
  ✓ The annual yield of biomass production is closed twice as much as alfalfa production.

• Strong ecological adaption and low-input requirement
  ✓ It can be cultivated strongly all over the southern areas of China.
How shall we get into ramie industry?

- Shortage of high protein feed is the key problem for the development of beef cattle industry, especially in the southern areas of China.
  - The price of beef is going up continually.
  - The gap of high protein feed in demand is more than 26,000,000 t.
  - Ramie is the optimal crop due to containing the expected content of crude protein and growing strongly in the southern areas of China.
It is an important work to search for sufficient source of culture medium in mushroom industry of China.

China is the largest production and consumption of mushroom in the world. The production accounts for about 70% of the world.

Traditionally, cottonseed hull is the main culture medium for cultivating edible mushroom. With the reduction of cotton plantation, the cottonseed hull is an unbalance between supply and demand so that the low-cost and sufficient source of culture medium is severe shortage.

Ramie also is the optimal crop due to its high biomass production, high content of N source, and good physical performance.
Why do we bring back ramie cultivation?

The research will make a new contribution for producing vegetable proteins feed and for making culture medium of edible fungi. It will be benefit for promoting the joint development of ramie plantation, livestock, and edible mushroom industry.

——Prof. Zhang Ziyi

Academician of the Chinese Academy of Engineering
Technique innovation

Variety Breeding

Forage Processing

Animal Feeding

Mushroom Cultivation

Technology promotion

Promotion of multipurpose ramie varieties

Technology application

Rame Silage

Culture Medium

Outputs products

Red meat

Edible mushroom

Technique roadmap of multipurpose use in ramie
What have we done and achieved?

A new variety dedicated to forage was bred by IBFC, which named **Zhongsizhu NO.1**. It is the first ramie variety used as forage in the world.

**Zhongsizhu NO.1**

Registration certificate of the variety
Advantages of the new variety---*Zhongsizhu No.1*

- High biomass production----18-24 t/ha ;
- Fast growing and strong regeneration ability----mowed 6-8 times a season ;
- Excellent nutritional value ----21% CP, 1% Lys, 4% Ca$^{2+}$ 。

**Comparison of nutritional value between ramie and alfalfa**

---National feed supervision and inspection center (Wuhan, China)
Processing techniques were invented for saving materials and optimizing forage performance.
### Main component of different types of silage

<table>
<thead>
<tr>
<th>Material</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude protein /%</td>
</tr>
<tr>
<td>Ramie shoots</td>
<td>20.4</td>
</tr>
<tr>
<td>Residues (ramie leaves and stem)</td>
<td>13.3</td>
</tr>
<tr>
<td>50% residues + 50% corn</td>
<td>10.1</td>
</tr>
</tbody>
</table>
Advantages of ramie silage

- **Maintain its nutritional quality** for a long time and improve the palatability.
- **Lengthen the time of supply** and avoid the effect of hot rainy season.
- **The resources-use efficiency** would be increased strongly by mixing straw of other crops.
A feed test has been done in a company, it indicates that the cattle culturist could save more than 1 $ each day per cattle using ramie silage compared with traditional feed. Meanwhile, it shows that the farmer will get 4500 $/ha from planting ramie. Besides, ramie silage is benefit for reducing the rates of the anti-inflammatory drugs.
Other forage products of ramie

Rami is processed into powder, plugs, and pellet for the convenience of storage and transportation.
The technological process of edible fungi cultivation using ramie residues.
Cultivated abalone mushrooms and needle mushrooms by using ramie residue

- The technique has been applied in some experimental stations and cooperative companies. The results showed that this technique has higher biotransformation efficiency, shorter production cycle and lower cost in comparison with traditional technique.
By using ramie residues to cultivate edible fungus, the rate of wheat bran is reduced by 20%, the production cycle is shortened by 6 to 8 days, and the biological efficiency is increased by more than 10%. Furthermore, the technology makes farmer earn more than 7500 $/ha from planting ramie.
Compared the nutritional value of abalone mushrooms cultivated by ramie residue and cottonseed hull

<table>
<thead>
<tr>
<th></th>
<th>Ramie residues</th>
<th>Cottonseed hull</th>
<th>Compare with the control ± %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>3.9</td>
<td>3.0</td>
<td>+30</td>
</tr>
<tr>
<td>Fat</td>
<td>0.2</td>
<td>0.3</td>
<td>-33</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>47.3</td>
<td>61.9</td>
<td>-24</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>2.4</td>
<td>2.2</td>
<td>+9</td>
</tr>
</tbody>
</table>

-Food Quality Supervision and Inspection Institute in Hunan (Changsha, China)
Advantages of the technique for edible fungi cultivation by using ramie residues compared with cottonseed hull and sawdust

• **N source** is reduced due to its high CP content.

• **Pesticide residues** is reduced due to its high ecological adaptability.

• Avoid the sensitive words “**transgene**” in China Market.

• Improve the **quality and relish** of mushrooms.
The planting areas of multipurpose ramie (*Zhongsizhu No.1*) had developed to 6758 ha and the multi-use techniques of ramie had extended to 10 million ha in the last three years.
As a national research institute, IBFC has done lots of work on the promotion of multi-use techniques in ramie without any profit. We taught farmers detailedly how to apply the techniques by various training. We believe that the multi-use techniques play an important role in increasing farmer’s income.
## Economic benefits

The benefits of scientific and technological achievements

<table>
<thead>
<tr>
<th>Application sites</th>
<th>Years</th>
<th>New returns($)</th>
<th>Net income($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lianyuan, Hunan province</td>
<td>2011-2012</td>
<td>23000000.0</td>
<td>9700000.0</td>
</tr>
<tr>
<td>Dazhou, Sichuan province</td>
<td>2010-2012</td>
<td>17090000.0</td>
<td>8306666.7</td>
</tr>
<tr>
<td>Xianning, Hubei province</td>
<td>2010-2012</td>
<td>15987500.0</td>
<td>6414833.3</td>
</tr>
<tr>
<td>Zhangjiajie, Hunan province</td>
<td>2010-2012</td>
<td>10866666.7</td>
<td>4923333.3</td>
</tr>
<tr>
<td>Wangcheng, Hunan province</td>
<td>2011-2012</td>
<td>700000.0</td>
<td>315000.0</td>
</tr>
<tr>
<td>Chengzhou, Hunan province</td>
<td>2012</td>
<td>1145666.7</td>
<td>520000.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>23000000.0</td>
<td>9700000.0</td>
</tr>
</tbody>
</table>
Social benefits

• The technology increases directly farmer’s income from 2100 $/ha to 3000 $/ha and the ramie industry can get more than 1.5 billion dollars per year. Moreover, it can provide employment opportunities.

• The technology ensures the supply of high-quality forage and promotes the development of grain-saving animal husbandry in southern of China.
Ecological benefits

- Ramie can be cultivated in hill areas due to its strong adaptability, developed root system, and strong ability of soil and water conservation.
- Ramie has a strong tolerant ability to cadmium. It can grow normally when the cadmium concentration of soil is up to 100 mg/kg.
How does foreground and prospect of ramie industry?

• China will maintain continually the greater preponderance in ramie industry all over the world in the future.

• The development of ramie in China impact significantly on global ramie industry.

• We have the responsibility to lead the ramie industry to a more efficient, economical, and ecological way.
• In China, the import quantity and value of textile fibers continuously increase from 2002. It indicates that ramie, as one of the most important fiber crops in China, will have a bright future.
How to improve the ramie industry

- Combination of ramie farming and animal husbandry

✓ Ramie farming can supply forage to animal husbandry, meanwhile, animal husbandry increase the income of ramie farming. Combination ramie farming and animal husbandry is benefit for the development of each other.
• Combination of economic benefits and ecological benefits
• Combination of high-efficiency agriculture and leisure agriculture

✓ Green foods are pursued enthusiastically in China due to the traditional culture and the food safety problems.
Thanks For Your Attention!