Research and industrial progress of oats in China

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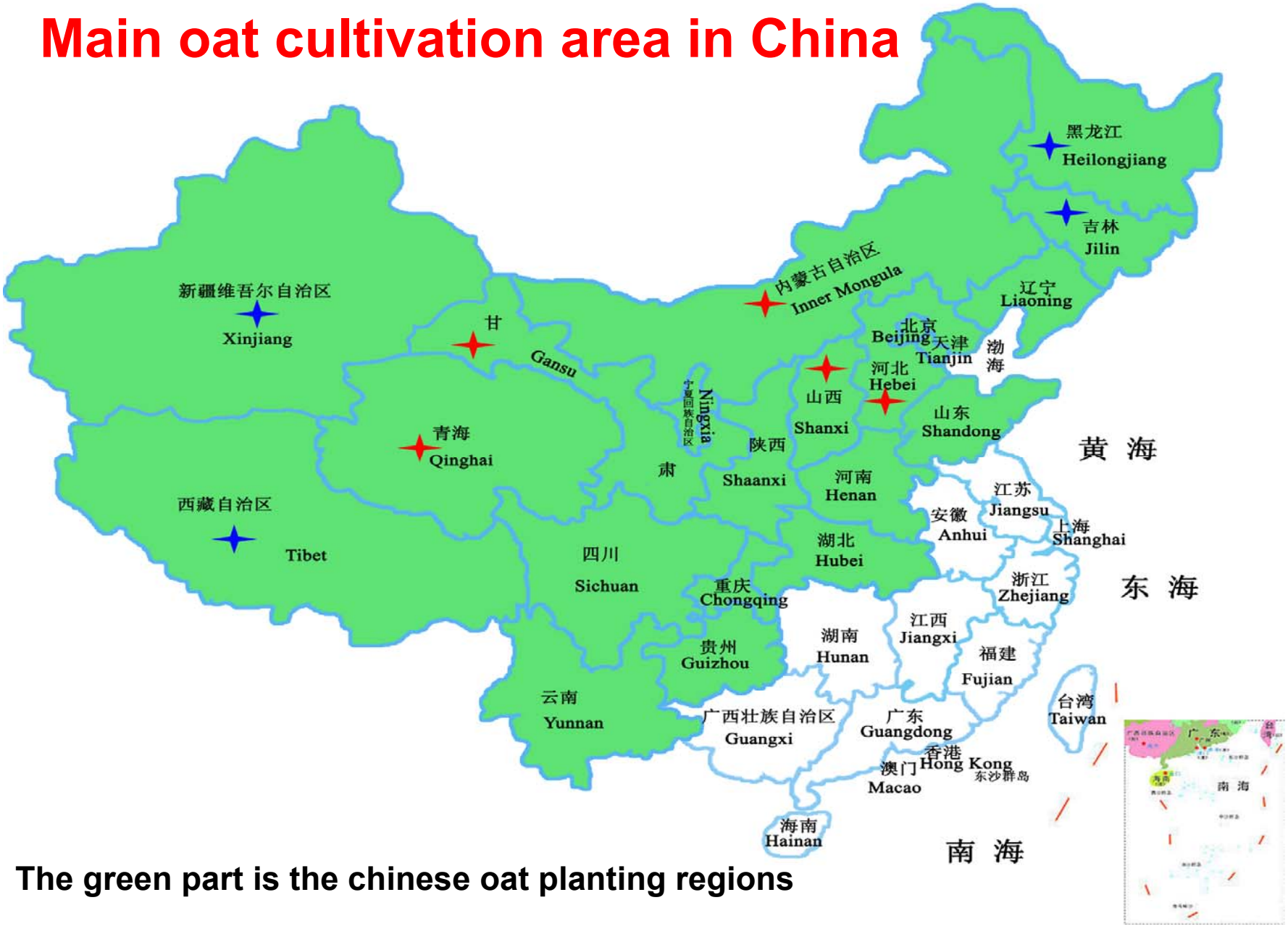
Naked Oat and Covered Oat

Main oat cultivation area in China



The green part is the chinese oat planting regions

Oat History in China

The oats are traditional crop in China, Naked oat is originated in China and has more than 2100 year history in China. Chinese oat growth area reached 1.13 million hectares in 1960s and declined from 1980s, dropped to about 0.3 million ha in 2003, the lowest in history. After that, the area increased gradually. There were about 0.7 million ha of oats in 2010, and total yield about 850 thousands tons, and start increase gradully the recent years, with the change of people's diet view, foods with health-enhancing functions are favored. With enriched nutrition and unique healthcare function, Oat food becomes more and more popular, which increases oat research and industry development.

The main planting province and yield in China

Province	Planting area (10^4 Hectare)	Total yield (10^4 tons)
Inner Mongula	15.0	15.0
Hebei	13.0	18.8
Shanxi	10.0	6.3
Qinghai	9.1	10.0
Gansu	8.0	12.0
Jilin	1.1	2.0
Ningxia	1.2	0.8
Yunnan	2.7	2.0
Sichuan	1.3	1.0
Guizhou	1.0	1.0
Total	62.4	74.2
Plus other	70.0	85.0

Government support oat researching in China

- The first oat key project in China since 2004 to 2010,

  7 million RMB
- Fund for oat Research in the Public Interest (nyhyzx07-009) since 2007 to 2010

  12 million RMB
- Fund form China oat Research System (nycytx-14) since 2008 to 2010

  27 million RMB
- Fund from China oat and buckwheat Research System (CARS-8) since 2011 to 2015

  98 million RMB
- China oat Improve Center in Baicheng, since 2012 to 2015

  12 million RMB

China Agriculture Research System(CARS)

China Oat and buckwheat research system

- To fulfill the basic technology requirement and research development work for Oat industry development, lead by Chief Scientist, the China Oat and buckwheat research system built the 4 function research lab and 16 complex demonstration station, this two ways combined as the oat industry research and development platform.
- The 4 function research lab including genetic breeding lab(5 Research Scientists), pest and disease control lab(2 Research Scientists), management and soil fertilizer lab (5 Research Scientists), and quality and utilization lab (3 Research Scientists).
- The 16 complex demonstration station including 11 proviences, spread in main oat planting area in China.

Distribution of China Oat and Buckwheat Research system

Oat and buckwheat Team in China

OAT RESEARCH SITUATION IN CHINA

- Oat breeding
- Oat germplasm collection and evaluation
- Oat cultivation research progress in China
- Biotechnology research progress on oat

Oat breeding in China

Oat breeding has experienced 5 stages since the foundation of P. R. China(Yang 2001).

1、**Landrace screening and application stage.** In the early 1950s.

2、**Varieties introduced and extension stage.** At the beginning of 1960s.

3、**Intraspecific hybridization breeding stage.** From the end of 1950s to early 1960s.

4、**Interspecific hybridization breeding stage**. Since 1980s, a lot of interspecific cultivars with lodging resistant, fertilizer and water tolerant, and high yield have been released, These cultivars increased oat yield by 20-40%, many types of germplasm were created with smut and rust resistance, big grain , high protein content and early maturity (Gu *et al*.1997; Zhao *et al*. 2003).

5、**Ploidy breeding stage.** With the development of interspecific breeding between hexaploid covered and naked oat, some problems such as prolonged hybrid dissection, poor stability and high husk rate emerged. In order to solve these problems, haploid breeding was conducted since 1980s.

Main Oat Varieties in China

Inner Mongula： 9 Varieties. (1 Covered Variety)
Hebei : 18 Varieties. (3 Covered Varieties)
Shanxi : 8 Varieties.
Qinghai : 7 Varieties. (6 Covered Varieties)
Xinjiang: 3 Varieties. (1 Covered Variety)
Gansu: 7 Varieties.
Jinlin: 12 Varieties. (3 Covered Varieties)

Total： 64 oat Varieties.
(50 Naked Varieties ;14 Covered Varieties)

Oat germplasm collection and evaluation

- **Oat germplasm collection and evaluation**
- **Quality analysis of oat germplasm resource**
- **Stress resistance identification of oat germplasm resource**
- The **Days to maturity identification of oat germplasm**
- **Genetic diversity research of oat core germplasm**

Importance of Chinese oat germplasm

- The Unique type of naked oat
- Important for food security in remote areas
- Strong adoptability to poor environments

Oat cultivation research progress in China

1、Life history and seeding Spring oat has 80-120d in China, On medium fertility soil, proper seeding rate is 6.0-6.75 m/ha (Wu et al. 2008)..

2、Fertilization, Nitrogen fertilizer is good for oat, Oat yield can be improved by applying N and P fertilizer with the ratio of N: P=1:2 or N: P=1:1. Top dressing N at booting stage can improve plant growth and grain yield (Ma et al.2008).

3、Irrigation Oats water consumption from tillering to heading about 70% of the total. The most sensitive time is 12-15d before heading, irrigation during this period is important to increase grain yield and quality.

4、Disease, insect pest and weeds control. Research on Disease, insect pest and weed control has just started.

5、Cultivation pattern Oat is mainly seeded in spring and harvested in autumn. But if use early mature variety, two harvest can be achieved. In Inner Mongolia and Jilin Province has already succeeded in two harvests of grain-grain or grain –hay (Ren et al.2009). Apart from single seeding, oat is often mixed with other legumes.

Biotechnology research progress on oat

1、Biotechnology research progress on oat

Molecular maker provides a good way to study the origin and evolution of oats. Chen Gang et al. established oat linkage map by use of RFLP, and fund 3 crown rust QTL (Chen *et al*.2001). Yun et al. isolated a cDNA clone (1448bp) from yellow leaf cDNA library, encoding β-Glucan enzyme and has 90% similarity in amino acid sequence with barley β-Glucan enzyme (Yun *et al*.2003).Not much has been done on oat SSR, ITS and other makers.

2、Gene transformation on oat Liang Shouyi (1984) first reported oat tissue culture from un-fertilized ovary in China. The research not very deep on this.There is no successful report on oat gene transformation in China at the present. Just like other gramineae crops, it is difficult to establish high frequency plant regeneration system on oat. Furthermore, not many scientists work on oat biotechnology as oat is just a minor crop in China.

OAT INDUSTRY DEVELOPMENT SITUATION IN CHINA

Food types of oat

In China, oat processing has consisted of 5 main series of products.

1、Oatmeal: account for 10-15% total processing capacity.

2、Oat flour milling and flour processing products: About 80% of the total processing. Main products are oat flour, oat noodle, instant noodle, puffs, oat crust, etc.

3、Oat rice: is the new product in the markets, and need to be debran, and roasting to deactivation enzyme, can mixture with rice to make oat rice, or used to cook oat porridge.

4、Oat drinks: mainly oat milk, fermented oat drink, oat beer, oat spirit, etc.

5、Oat value added processing products: 5% of the total processing capacity; mainly oat bran, oat cosmetics, oat capsules, and oat extracts (β -Glucan and diet fibre).

Oat food processing

- There are 21 large-scale oat processing companies in Heibei province, 16 in Guangdong province, 6 in each of Beijing, Jiangsu, and Shanxi provinces, and 4 in each of Zhejiang, Gansu, Innermogolia, Shandong, Jilin, and Fujian provinces (Ren *et al.*, 2011).
- Oat products in northern part of China are minimally processed oatmeal, oat rice, oat flour, and oat noodle.
- In the south, produce oat dietary fiber, oat milk, oat alcoholic, oat tea, oat beverage, and oat medical care preparations.
- In China Naked oats has special processing advantages compared with covered oat; it can increase the utilization ratio by 30%, reduce energy consumption by 25% and equipment investment by 30%, and can also reduce storage and transportation demanding (Hu *et al.*, 2009).

Oat food processing

- Problems in the oat industry in China:

Low grain yield resulting in low economic profit;

Oat processors in traditional production areas are Self-sufficient with low level processing technique;

Most of oat varieties can not meet processing requirements with poor grain processing quality;

Investments to oat industry is not enough and added value of oat products is quite low;

People do not know much about oat;

Majority of oat processing companies are of small size;

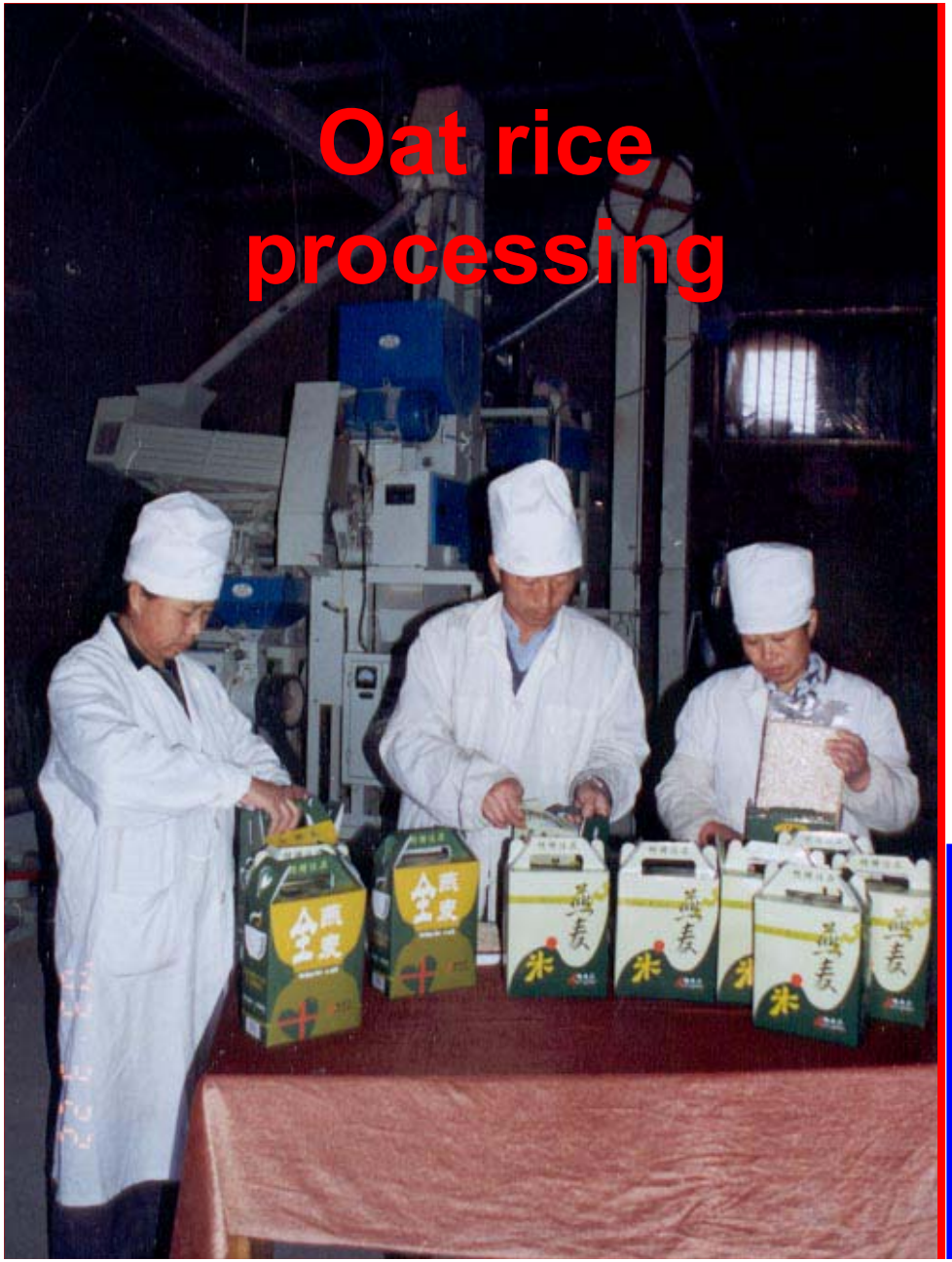
Commercial degree of oat hay is lower.

Oat food processing

- The advantages of oat industry in China lie in:

  abundant oat germplasm resource, wide range of products, abundant diet culture, high percentage of organic products, high potential of organic market, as well as increasing social requirements for oat healthy food.

Oat rice processing



Oatmeal processing


鹤龙江
Helonghui
白城燕麦
特供
白城
燕麦片
白城燕麦
白城
燕麦片

Oat flour and traditional food processing

Oat noodle processing

Oat beverage

- Oat beer, oat alcohol
- Oat-soybean milk, oat drink
- Oat tea

Oat cosmetic

- Extract the ß-glucan, oat peptide, oat lipid used for moisture-preserving hair conditioner, skin moisture preserving

Other oat products

OAT SCIENTIFIC RESEARCH AND INDUSTRY DEVELOPMENT TREND IN CHINA

- Oat scientific research trend
- Oat industry development trend in China

Oat scientific research trend

- In consideration of fast development of oat research in the past 10 years and more attention to healthy food, scientific research on oat will be focused on the following aspects.
- First is the oat germplasm resource research. It is the origin of new variety and the base of function genes identification and cloning.
- Second is the oat breeding. With the development of oat industry, present varieties can not meet the needs of processing and market, and special cultivars should be released as soon as possible. Disease and insect pest resistant variety will benefit organic oat production.

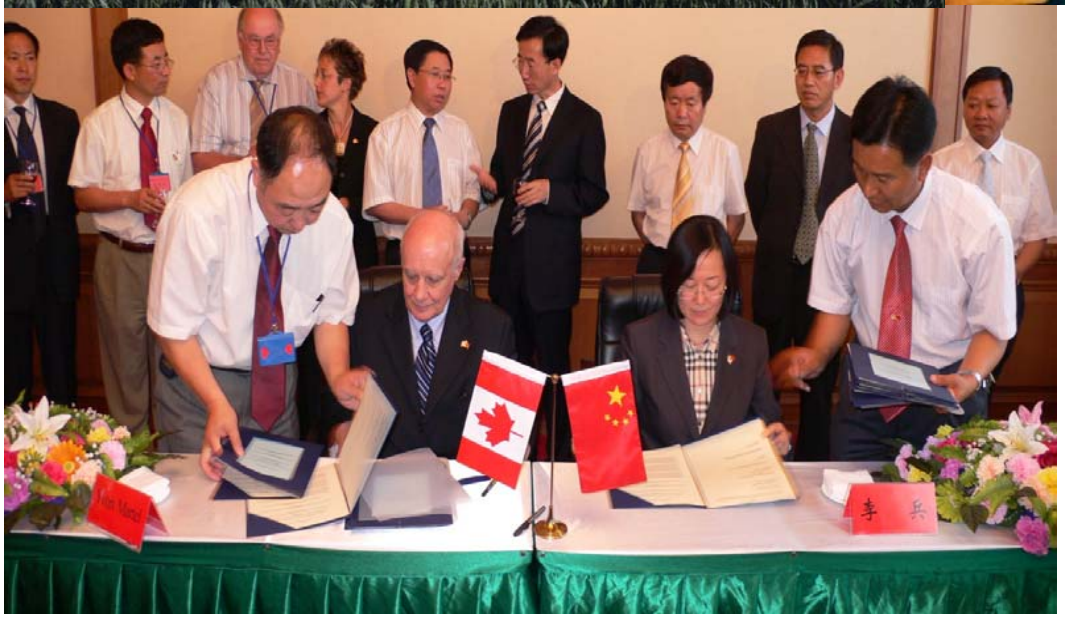
Oat scientific research trend

- Third is new cultivation technology combination, successful establishment of oat in saline and sandy soil made it possible for oat to improve these soils, the corresponding cultivation technology is necessary for further demonstration and extension. Oat disease, insect pest and weeds control are another fields need to be improved.
- Fourthly, functional component of oat is another research field to provide opportunity for new products and market development.
- Fifthly, popular food and intensive processing techniques should be strengthened. Finally, the combination of traditional breeding with biotechnology will be one of the main research trends of oat.

Oat industry development trend in China

China is the largest oat production country in Asia. Since 2007, oat import has risen dramatically to produce oatmeal. With its functional and nutritional characteristics of β-glucan, oat is considered as a healthy food. This is well accepted nationwide. With the development of processing technology, more oat products or oat-based products are needed to meet different requirement of people at different ages. Traditional and modern processing technology combination will improve oat industry development in China. Good International cooperation will bring new opportunity for oat research and industry development in China.

China-Canada oat cooperate researching



Baicheng, Jilin, China, Cooperation with AAFC since 1998
China-Canada Science and Innovation Centre on Oats

China-Canada International Oats workshop in Baicheng, Jilin, China

June 24-26, 2004


热烈祝贺中国•白城第二届中加燕麦开发战略国际研讨会胜利召开！
Congratulations on the Opening of the 2nd China-CanadaInternational Workshop on Strategic Development of Oats
June 20-22, 2007

Baicheng Oat Varieties

9 new naked oats and 3 covered oat varieties have been registered in Jilin Province

Naked oats growing on salinization & alkalization fields (pH 8.5-9.1)

In the western part of regions of Jilin Province, Soil degradation, desertification, salinization & alkalization is a very serious problem, especially salinization & alkalization has become the major problem in crop production. For these reasons, Baicheng city has a lot of degraded field, and these fields are very poor, oats can grow well in these regions.

The Baicheng Oat Field

What should we do for the next crop of oat ?

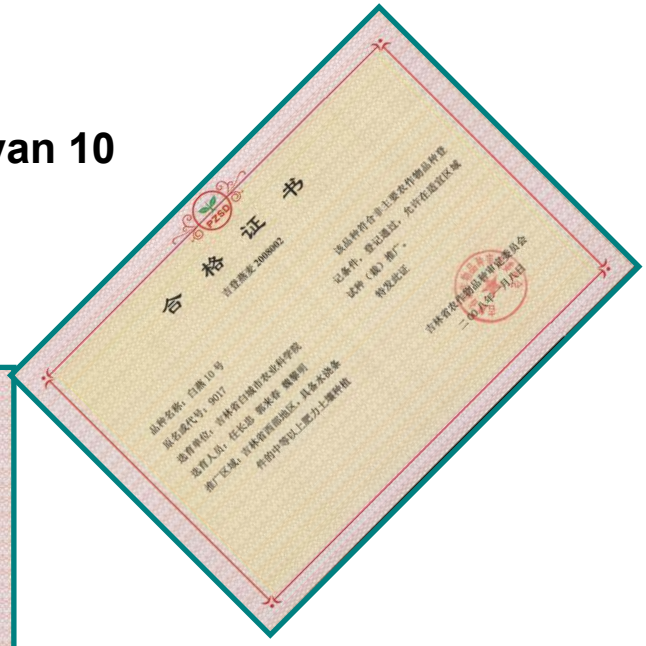

上海STAR
3060

Three new very early oat varieties for Double Cropping

Baiyan 8

Baiyan 9

Baiyan 10



Oats Double Cropping
(Spring sowwing and summer harvesting)

Oats double cropping (Zero tillage in second crop)

Oats double cropping (summer sowwing and fall harvesting)

Acknowledgements

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