

Sweet Sorghum Genetics, Breeding and Plantation Studies in China

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Presentation Outline

- **Sweet Sorghum Economic Characters Genetics Studies in China**

- Plant Height

- Stalk Texture

- Juice Percentage

- Juice Brix

- Grain Weight per Spikes and grain yield

- **Sweet Sorghum planting in China**

- Area

- Purpose

- Cultivars

- Yield

- Problems

- **Sweet Sorghum Breeding in China**

- Breeding Objective

- Approaches to Breeding and Main Cultivars

- Problem

- Breeding in Hebei



Sweet Sorghum Economic Characters Genetics Studies in China

- **Plant Height:** Plant height is significant correlation with the yield of the stalk. Plant height relates to the number of nodes and length of internode. The long internode is dominant over the short internode; length of internode is sensitive to the temperature and water supply. The more nodes is dominant over the less nodes; the number of nodes is photoperiod sensitivity. The more number of nodes are, the long growing period is. Tall is dominant over the dwarf stalk. Long photoperiod, high temperature and sufficient water supply are necessary for getting high plant and stalk yield.
- **Juice Percentage:** Juice percentage of the stalk varies widely among varieties and growing conditions. The range is 51.19%-80%. Juice percentage of the compact stalk varies in a small range and the juice can keep for long time. The compact stalk is with good keeping quality. It is difficult to getting the posterity with juice by using the variety without juice as the crossing parent.
- **Juice Brix (Sugar Content):** Porous without juice is dominant over porous with juice. Stem sugar content is a quantitative inheritance controlled by a minor multiple genes. The genes controlling Low juice Brix were partially dominant; a few genes controlling high juice Brix are dominant. Few combination is superdominance. The broad heritability of sugar degree (Brix) in stalk is not high, the character is easily affected by environment, like as soil nitrogen content, temperature. There is no correlation between stem sugar Brix and plant height or blossom date. There is a significant negative correlation between sugar degree and 1000-kernel weight.

Sweet Sorghum Economic Characters Genetics Studies in China

- **Stalk Texture and its Value in use for Biofuels**

Table 1 Sorghum **Stalk Texture** types and its Value in use

Types	Porous	Compact	Juicy	Sugar Content	value in use
1	√		No	No	Cellulose
2	√		√	Low	Cellulose
3	√		√	High	Sugar Cellulose
4		√	√	Low	Cellulose
5		√	√	High	Sugar Cellulose

- **Grain Weight per Spike and grain yield**

Most of sweet sorghum variety is with low grain weight per spike and grain yield. There is a significantly negative relation ship between grain yield and stalk sugar (Cao, Junfeng, 1982). A few sweet sorghum variety is with high grain weight per spike and grain yield. Some hybrid is with high grain yield and high sugar content. It is best way to get high grain yield and high sugar yield by using hybrid.

Sweet Sorghum planting in China

- **Area:** To develop the biofuels must not compete with food producing in China. saline/alkaline land is fit for planting sweet sorghum in China. The area is about 1000 million ha. But at present, Sorghum planting area is about 20 million ha; Sweet sorghum planting area is less than 1000 ha.
- **Purpose:** Grain sorghum is used as raw material to produce alcohol for drink or as feed. Sweet sorghum is used as raw material for producing biofuels test or forage.
- **Cultivars:** M-81E, Lvneng No.1, 2, 3 , Nengsi No.1 and other varieties are planted at present. Chuntian No.2, Liaotian No.1, 2, Nengsiza No.1 and other hybrids are planted at present.
- **Yield:** 15 sweet sorghum cultivars was planted in saline-alkaline land with deferent salt content in four sowing times in 2006-2007. The results show that:
 - average fresh stalk yield: 44.830t/ha; range: 30.675 - 79.365 t/ha.
 - average juice percentage of fresh stalk: 66.5%; range: 60-73%
 - average juice Brix: 15.48%; range: range: 11-21%
 - average ethanol yield: 22.78t/ha; range: 1.206- 4.056 t/ha.
 - average dry bagasses yield: 6.856t/ha; range: 4.655 - 10.556 t /ha.
 - average dry leaf yield: 2.143t/ha; range: 1.282 - 4.160 t/ha.
 - average grain yield: 2253kg/ha; range: 1.470 - 3.497 kg/ha.



The sweet sorghum demonstration farm in Hebei Salty and alkali land



Nengsi No.1 demonstration farm in Hebei



M-81E and Nengsi No.1



M-81E in China

Sweet Sorghum planting in China

Problems

- 8 tests or trials have been done in saline-alkaline land in 2006-2007 (variety test, date of planting test, fertilization field trial, plant density trial, irrigation trial, soil salinity test, reaping time test, stalk storing time test). The results show that Low emergence rate of Seedlings, serious Insect Pest, long growing period, short reaping and storing time are the main problems for biofuels.
- The National sweet sorghum regional test shows that lodging and low sugar content are the problems for biofuels.





percentage of seedling success is low in the Salty and alkali land



Aphides living on the leaf of sorghum



Aphides damage the spike



Aphides damage the stalk and leaf



Aphid controlling is difficulty



Seedling Under the damage of aphid

Aphid



Plant damaged by the borer



- Yield reduction
- Juice reduction
- Shorten storage period

borer



Stalk damaged by the borer



The stalk damaged by the borer don't suit to store

Sweet Sorghum Breeding in China

- **Breeding Objective:** high biomass, high and steady sugar content, resistance to major pests, different maturities are as the breeding objectives for alcohol making.
- **Approaches to Breeding of Cultivars :** introduction and breeding by selection; utilization of heterosis; cross breeding; induced mutation breeding; transgenic breeding. The cultivars were developed are in the table 2.
- **Problems:** short of resistance to major pest, early maturity and high sugar content germ plasm. Short of Transgenic technic and available genes.

Table 2 The developed Cultivars in China

cultivar	Plant height (Cm)	Stalk yield (t/ha.)	Brix %	Grain yield (t/ha.)	Growing period (days.)
M-81E	420	75	17	3.31	160
Chuntian no.2	395	73	18	4.52	140
Liaotian No.1	410	75	16	4.51	150
Nengsiza No.1	420	76	16	4.50	130
Yuantian No.1	400	73	17	3.20	150
823	420	60	14	3.75	150
Nengsi No.1	350	47	16	3.0	100



早熟品种能饲1号在盐碱地上的生长情况

Early maturity variety "nengsi No.1" growing in Salty and alkali land



盐碱地上种植的晚熟甜高粱

Lvneng No.3-Late maturity variety growing in Salty and alkali land



Hybrid of sweet sorghum



Romania delegation visit the breeding trial field



Nengsiza No1

Sweet Sorghum Breeding in Hebei of China

Contrapose the questions in planting and breeding, the breeding works have been done in Hebei Academy of Agricultural and Forestry Sciences are as follows.

- Breeding of the male sterile line with the resistance to aphid.
- Breeding of the male sterile line with high sugar content.
- Breeding of the restoring line with the resistance to aphid, and with the high sugar content.
- Breeding of the B-line with the resistance to aphid high sugar content.
- Developing sweet sorghum and grain sorghum hybrids with high yield and early mature.
- Transgenic breeding.



甜高粱保持系和不育系608A甜秆特征

The stalk character of sweet sorghum A-line



抗蚜恢复系后代

The R-line whit resistance to Aphid



不育度达95% ;
不育株率99%

抗蚜不育系选育Breeding of A-line with Aphid resistance

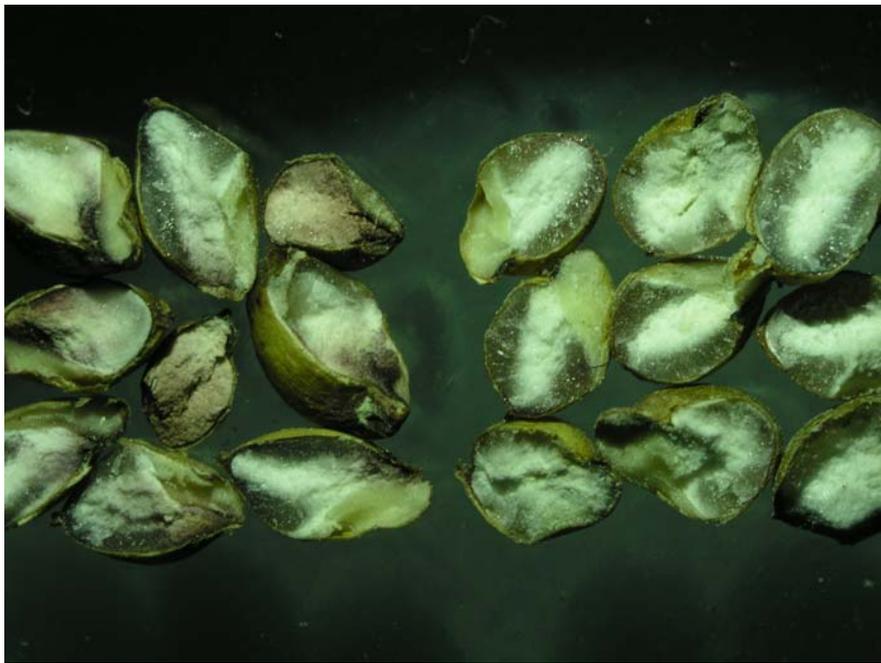


抗蚜不育系的抗性 Aphid resistance of the A-line



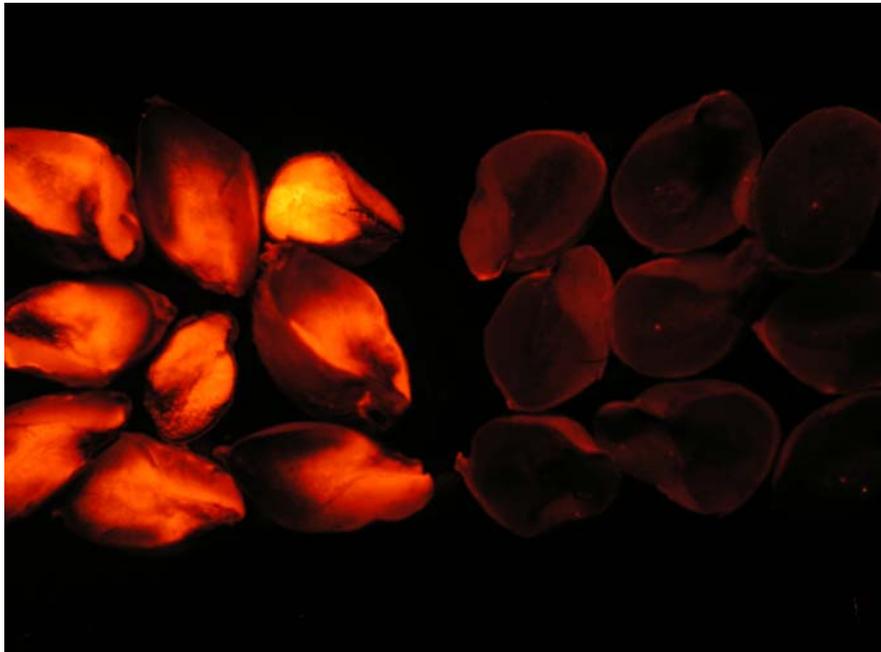
T93: A sweet sorghum R-line with high sugar content (Brix degree up to 23%) and the genes of sugar content in its combinations show superdominance sometimes. Its growing period is about 100 days.





带有红色荧光蛋白标记转基因引
物处理后种子在白光下无差异

sweet sorghum seeds under
white light.



带有红色荧光蛋白标记转基因引
物处理后种子在荧光下为红色

sweet sorghum seeds under ultraviolet
radiation.

Left: transformed is read;

Right: untransformed is dark.

cooperation

We hope to cooperate on:

- **transgenic breeding to resist the borer;**
- **marker-assisted selection for high sugar content and the resistance to aphid;**
- **Breeding of Short growing period and high biomass;**
- **Breeding of sorghum hybrid with high grain yield which can be planted in fertile soil and suit machine reaping.**



Thanks!
Welcome Your Suggestions
Welcome to cooperate

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