Mechanized Crop Production in China

Prof. Zhang Dongxing

E-mail: zhangdx@cau.edu.cn
● Population 1.3 billion
(20% of the world’s population)

● Arable Land 121.7 million ha
(7% of the world’s arable land)
Grain production in China today

- **Rice**: 200.04 million t (29.7 million ha)
- **Corn**: 200.08 million t (33.0 million ha)
- **Wheat**: 100.2 million t (23.0 million ha)
- **Soybean**: 14.8 million t (8.0 million ha, importing 55 million t)
- **Potato**: 86 million t (5.7 million ha, 14.4t/ha)

**Total**: 580 million t
Different grain production area in China

Different farming system in terms of geography

● One crop a year - North east, North west, inner M
● Two crops a year - Most areas in the middle area
● Multi crops a year - very South area
Main crops mechanization production in China

- Rice machine planting 31.7%, machine harvesting 73.3%
- Corn machine planting 82.3%, machine harvesting 42.8%
- Wheat machine planting 86.5%, machine harvesting 92.3%
- Soybean machine planting 64%, machine harvesting 55.3%
- Potato machine planting 21.4%, machine harvesting 19.6%

Technologies need to be developed & extended in China

- Rice planting or transplanting
- Corn harvesting
- Potato planting & harvesting
Rice production
Ways of rice planting

1. Broadcasting

- 30% broadcast manually
- Random, not even, no rows, easy lodging
2. Drilling direct in dry soil

Laser leveling equipment is needed for this kind of planting
3. Drilling in mud
4. Precision drilling in mud
5. Transplanting
6. Random transplant

7. Transplant with soil on
Ways of rice harvesting

1. Manual harvest
2. Reaper
3. Full feed harvest
4. Head feed harvest
Ways of rice harvesting

5. Stripper
Corn production

- Corn plant area 33 million ha
- Volume 200.8 million t in 2012
- Importing 6 million t from other countries every year
World Corn production

种植总面积：1.53亿hm²
总产量：7.92亿吨
单产：5.2t/hm²
（346kg/亩，中国365kg/亩）

各国玉米总产及单位面积分布图（吨/公顷 数据来源：FAO）
## Seven Wonders of the Corn Yield

<table>
<thead>
<tr>
<th>Rank</th>
<th>Factor</th>
<th>Value</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weather (气候条件)</td>
<td>70+</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen (土壤肥力)</td>
<td>70</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Hybrid (品种)</td>
<td>50</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>Previous Crop (轮作倒茬)</td>
<td>25</td>
<td>10</td>
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<tr>
<td>5</td>
<td>Plant Population (种植密度)</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Tillage (土壤耕作)</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Growth Regulators (生长调控)</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

玉米体系赴美考察报告 2010.11
1、Weather - 27%

P.R.C

USA
2、Nitrogen-26%

有机肥+秸秆还田

土壤有机质含量：4~6% VS 1%

高产稳产农田土壤
(玉米产量:17-20吨/公顷)

(Cassman & Dobermann)
Results
3、Population-8%  3000~3500株/亩 VS 6000-6500 株/亩

密度决定穗数，是产量重要影响因子之一

杨利华提供
4、Tillage-6%
土壌严重板结。作物根系生长发育的适宜容重是1.1～1.3g/cm³。而全国平均耕层土壤容重达1.38g/cm³。

耕深明显变浅。全国平均耕深为16.5cm，其中东北地区仅15.1cm，远低于22cm的基本要求，与美国的35cm相差甚远。
Hard Pan 6cm-12cm。Bulk density 1.52g/cm³ 严重影响作物根系生长发育。

长期小拖+浅旋耕作，反复压实
以深耕为主，松整结合+秸秆还田的耕作模式

玉米根系沿土壤缝隙生长
针对我国广大农村地区不大可能购买大型拖拉机的现实问题，研发与中型拖拉机相配套的"振动式"深松机械，降低牵引阻力和动力消耗。与非振动深松作业相比，振动式深松机的牵引阻力降低13~18%。
苗期深松结合施肥作业进行，一次进地完成两项作业。
5、Plant

How to plant corn after wheat harvesting?
This is a problem for 2 crop a year area
Move straw out of fields manually
Then non-till planter
Planter

机械式排种器

简易式无单体仿形机构播种机

槽轮式排种器——穴播机，低速作业，不能实现精量播种

勺轮式排种器——属于精播机，低速作业，重播率漏播率偏高
Or burn straw in fields directly
Problems caused due to straw burning in fields

Air pollution and fire disaster
interplant by hand or a single row planter
气吸式播种机是依靠空气吸力将种子均匀地分布在型孔轮或滚筒上完成播种作业过程。它具有种子破碎率低、适用于高速作业等特点。但它对气密性要求较高，风机需要消耗大的功率，结构相对较复杂，且需要对种子进行分级处理。存在地头缺苗问题。
Blowing type of Non-till precision Planter

适于黄淮海区的小型气吹式玉米精量播种机

具有单体仿行功能

具有主动防堵功能
气吹式播种机具有种子破碎率低、适用于高速作业等特点。同时它对气密性要求不高，风机消耗功率小，结构简单，且不需要对种子进行分级处理。
Non till or Precision planter with fertilizer application in north areas

Residues decomposed
6. Management
7. Corn harvesting

We have so many types of corn harvesters. Why should the harvesting level be so low?

1. Row space different
2. Too many varieties
3. Different agronomy systems
4. Planting random
Head changeable corn picker
Self propelled corn picker & Husker
玉米联合收获工作原理
茎杆铺放式玉米收获机
穗茎兼收型玉米收获机

具有切断、收集、喂入、切断、抛送功能
Different planting way & style
Row space 30cm, 40cm, 50cm, 55cm, 60cm, 65cm, 70cm, 90cm
行距不一致
（是制约机械化收获的最主要因素）

行距有 40cm, 50cm, 55cm, 60cm, 65cm, 70cm），不利于机械化收获作业。

不对行收获造成的问题—降低作业效率，对辊处容易堵塞。
行距的不统一对机械化收获而言，不仅增大了作业难度，降低机器生产效率，而且增大了收获损失率。

当前条件下，提高我国机械化收获作业水平见效最快的措施应该是种植行距的一致性。

小窄行及全喂入式是发展方向吗？
Solution in future

*Equipment Must Suite the Crops and the Types of Farming*

*Breeding Crops to Suite Machinery*
经验—规模化生产，标准化种植

平作、行距一致
美国：76cm行距(个别90cm)
澳大利亚：90cm行距
欧洲：75cm行距（25cm的倍数）
国外直接脱粒收获
Wheat Planting

● Wheat plant area 23 million ha (101.8 million t output)
● 80% planed & harvested by machine
Wheat harvesting
Potato production
Importance of potato production

- Eggs have very high nutrition, it is just next to Potato
- UNESCO say 2008 is the year of potato, and tubers are “babies hide in the soil”
- Nutrition compared with apples: VB1 10 times, VB2 3 times, VC 3.5 times, calcium same.
- 1 kg potato = 3 kg apple in terms of nutrition.
- a tuber = 120-150 calorie = a bowl of rice
- Solution for food safety
Importance of potato production

- 5.7 million ha, 86 million t in China every year
- Investment in potato production in China: total 2 billion RMB, but only 0.2 billion by the government.
- Processing: 5% in China, 59% in France, 47% in Holland, 76% in the USA
The use of potato

- 菜薯—on the table, fresh tuber
- 淀粉—Starch
- 全粉或雪花粉—Granular or Flake
- 薯条—French Fries (Russet Burbank)
- 薯片—Potato Chips (Atlantic)
Tree harvesting seasons

- **North/West**: Aug/Sept
  - Hohhot
  - Baotou
  - JiuQuan
  - XiaHeQing*
  - JinTai
  - LanZhou

- **Southern**: Feb/Mar
  - Guangdong*
  - Beihai

- **East**: June/July
  - HeBei*
  - Beijing
  - Nanjin*
  - ShanDong

- **Southwestern**: Feb/Mar
  - KunMin
  - ShanDong
  - Shanghai

Seeds Flow Chart:

- **Plantlets** → **Generation 0**: Greenhouse Growing; Store 6-9 months at least
- **G 1 seeds** → **G2 seeds**: In Seeds Farm; Store 6 months
- **In seeds farm or contract**: G3 as Chip-stock For PC production or Storage

China Agricultural University
Mini-Tuber

G0 Seeds for continuous Growing to the G1 seeds
Planting - Seed Treatment - 滑石粉 (Talcum) + Topsin

Warm up after 3-6 month storage - dormancy
China Agricultural University

Proper field management

Night shade
Diseases & insects control

Bacterial welt

wire worm
China Agricultural University

early/late blight

Tubers affected by late blight after a week storage
Proper irrigation is important
Quality control
Health Growing:

--- Potato Flower

--- Growing time: 90 days to 110 days
This operation is needed and very important for 2-crops a year areas
Just wait for enough mature in 1 crop a year area
Manual harvesting
Shovels
Structure of a digger
Harvest flow by diggers

- 挖掘铲
- 升运链
- 振动筛
- 铺放
- 人工捡拾
Small diggers
Picking, sorting and shipment
Combine harvest and cleaning, shipping
Potato Bulk Loading

Benefits:

1. No Potato shipping damage
2. Bulk Storage for long time store
3. Quickly loading & unloading
One Kind of Unloading System
Bulk Storage for Chip-stock

**Benefits:**
1. No-people handling to prevent bruising
2. Good air-flow for ventilation
3. Even Temperature and Humidity
4. Good sprouting control
5. Long time storage

Reloading System from cool store
Enjoy the good quality chips and fries
Flake—Artificial Fabric Chips
Questions & Discussion
Thanks!