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# 中国主要粮食作物生产机械化

## Mechanized Crop Production in China

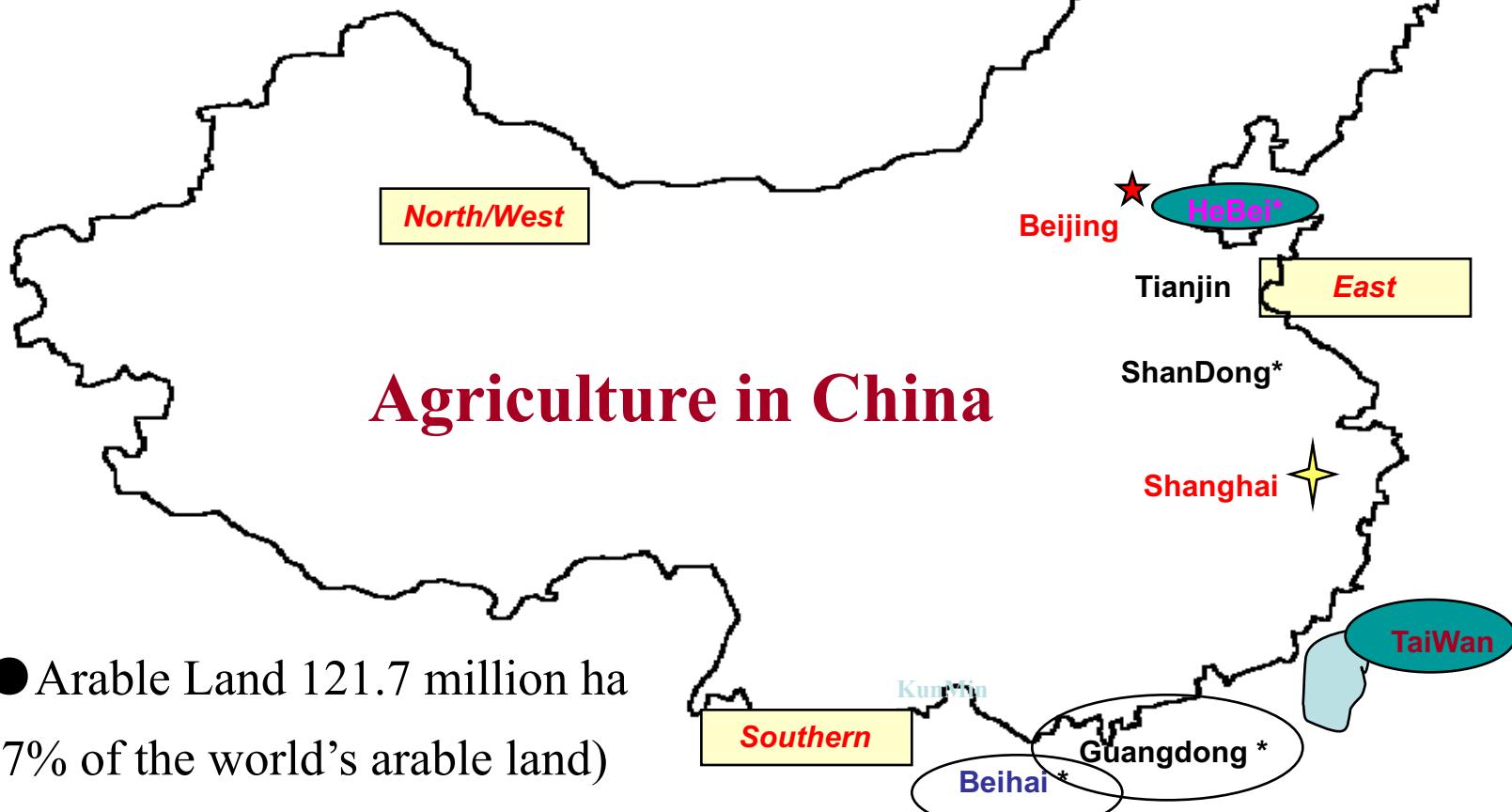
中国农业大学  
College of Engineering  
**China Agricultural University**

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- Population 1.3 billion  
(20% of the world's population)



# 中国作物布局

North Cotton Belt



Soybean Belt

Belt

Corn Belt

黑 龙 江

吉 林

Corn

Belt

Wheat /Corn

/Soybean Be

上 海 市

Rape Seed

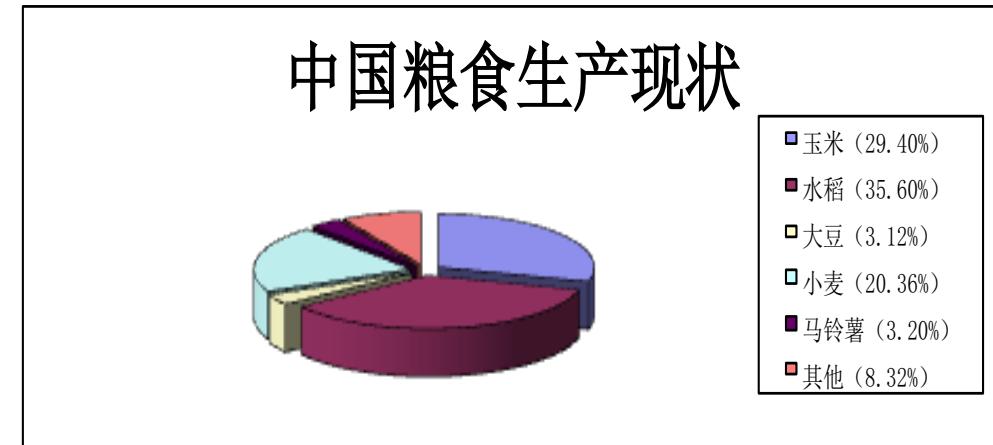
Belt

Rice  
Belt





## 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 )
- Soy bean 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**



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## 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 develop & extend in China

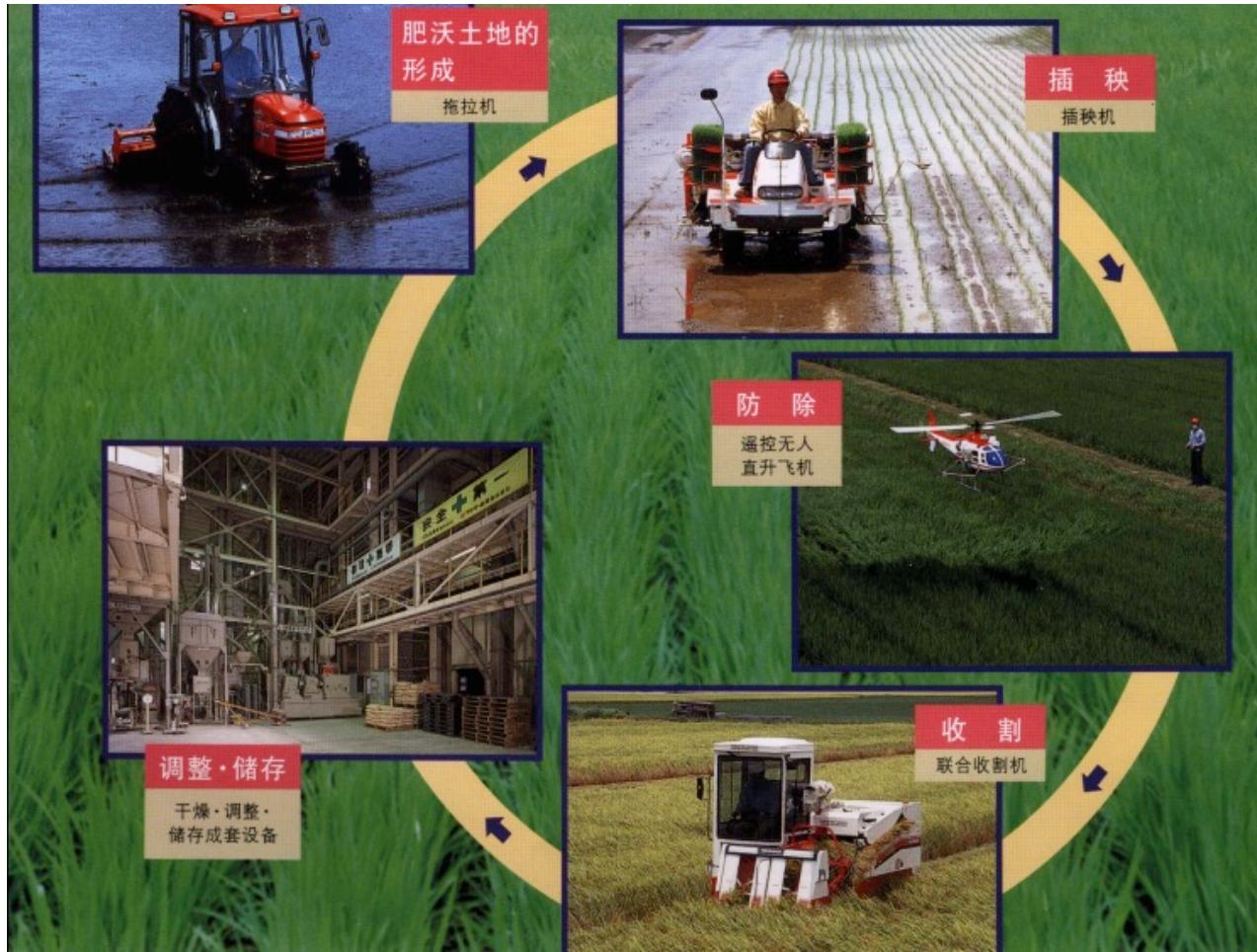
- Rice planting or transplanting
- Corn harvesting
- Potato planting & harvesting



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# Rice production





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## Ways of rice planting

### 1. Broadcasting

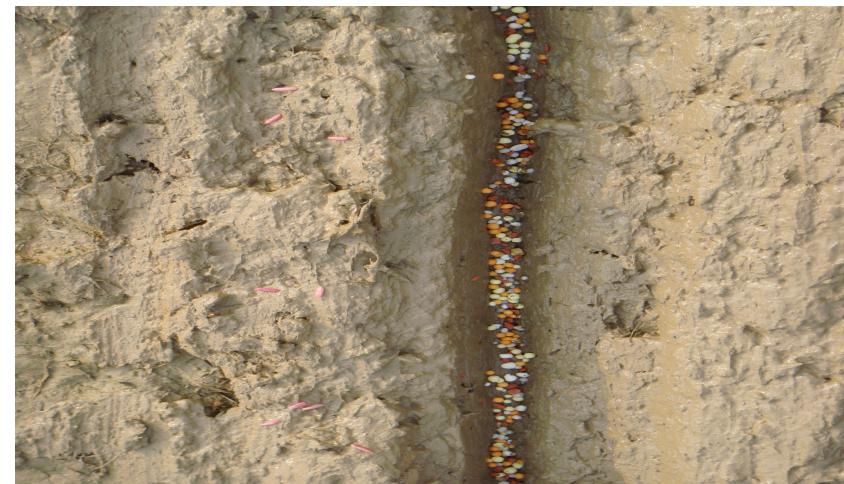
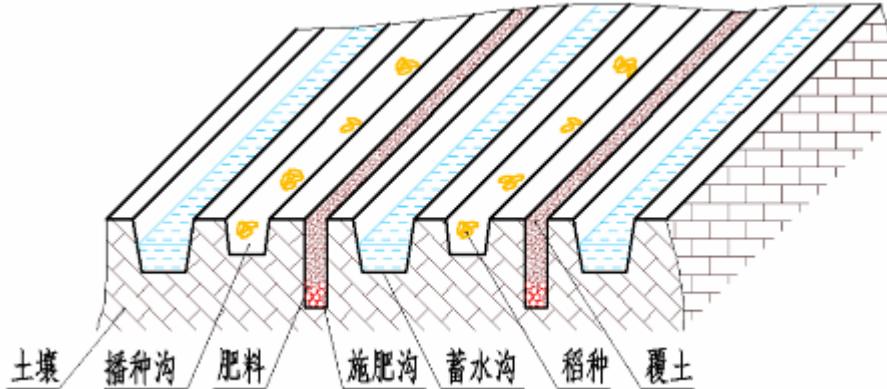
- 30% broadcast manually
- Random, not even, no rows, easy lodging





## 2. Drilling direct in dry soil

Laser leveling equipment is needed  
for this kind of planting





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### 3. Drilling in mud

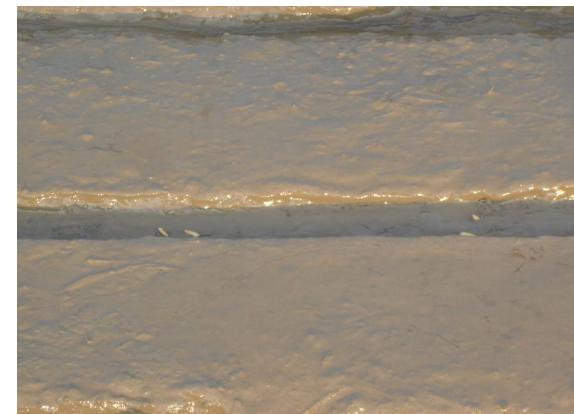




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## 4. Precision drilling in mud

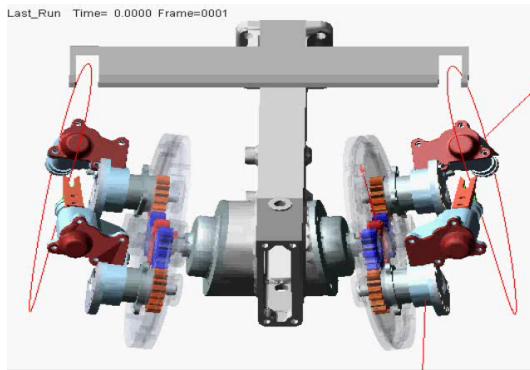




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## 5. Transplanting



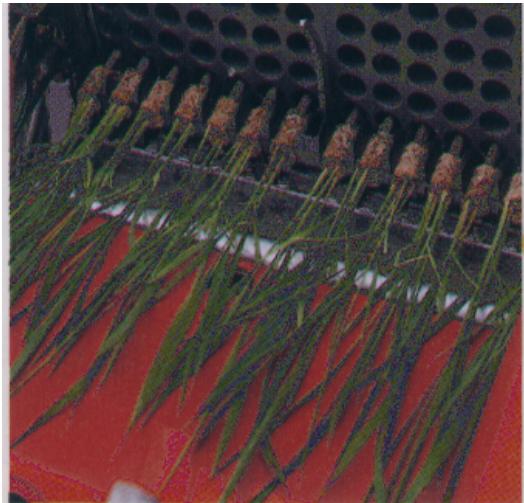


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## 6. Random transplant

## 7. Transplant with soil on





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## Ways of rice harvesting

1. Manual harvest
2. Reaper
3. Full feed harvest
4. Head feed harvest





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## 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



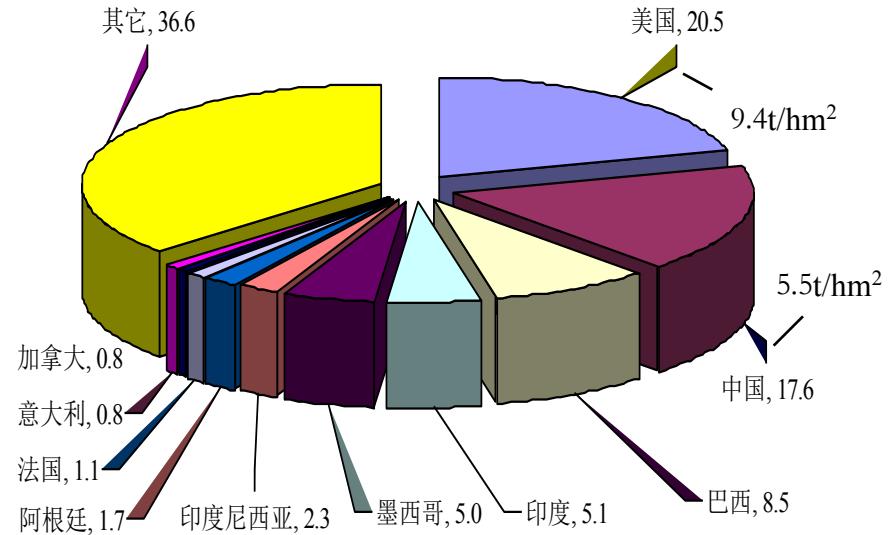
# World Corn production

种植总面积: 1.53亿hm<sup>2</sup>

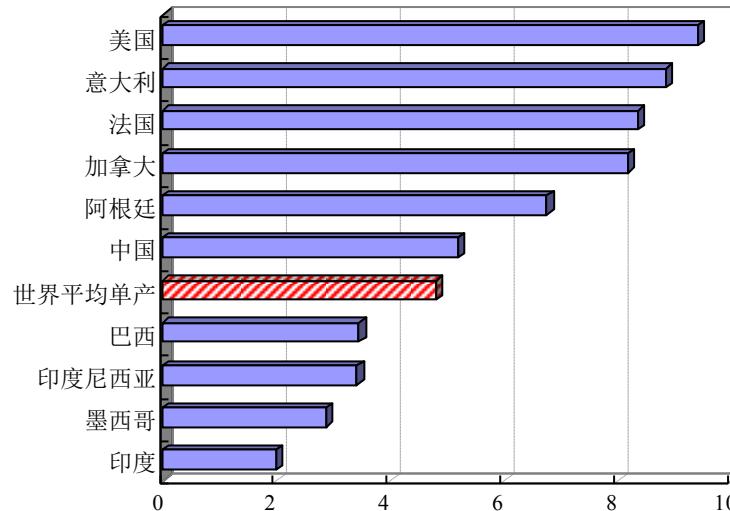
总产量: 7.92亿吨

单产: 5.2t/hm<sup>2</sup>

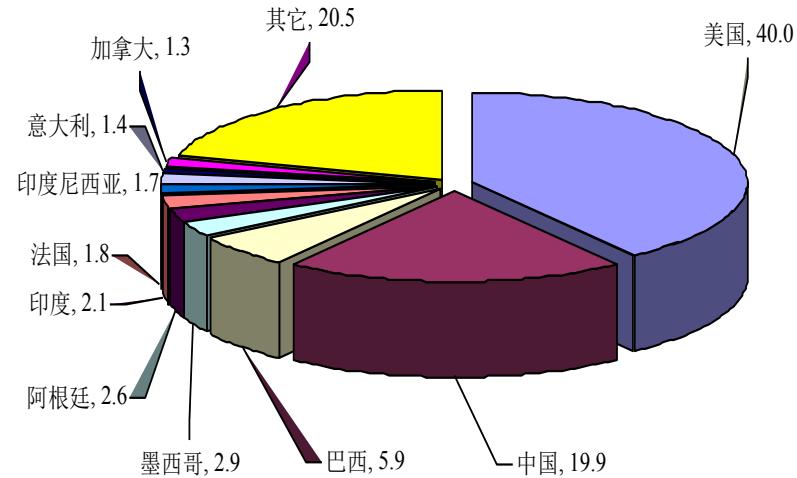
(346kg/亩, 中国365kg/亩)



各国玉米种植面积比例分布图



各国玉米总产及单产分布图 (吨/公顷 数据来源: FAO)





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## Seven Wonders of the Corn Yield

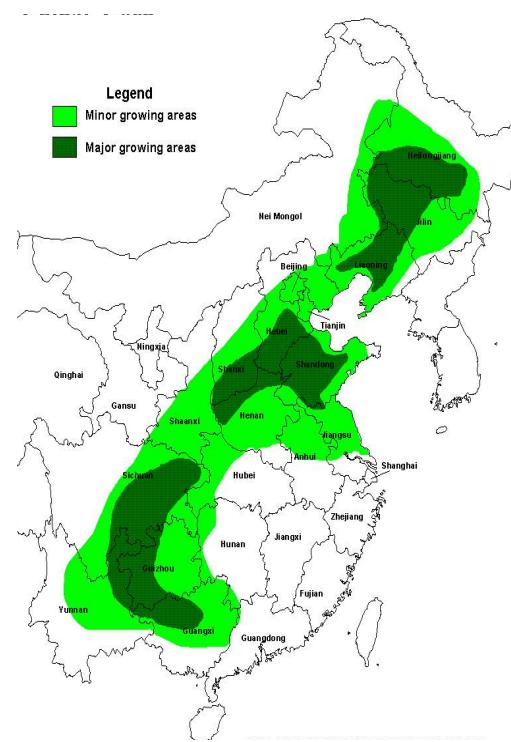
Rank	Factor	Value bu/acre	%
1	Weather (气候条件)	70+	27
2	Nitrogen (土壤肥力)	70	26
3	Hybrid (品种)	50	19
4	Previous Crop (轮作倒茬)	25	10
5	Plant Population (种植密度)	20	8
6	Tillage (土壤耕作)	15	6
7	Growth Regulators (生长调控)	10	4

玉米体系赴美考察报告 2010.11

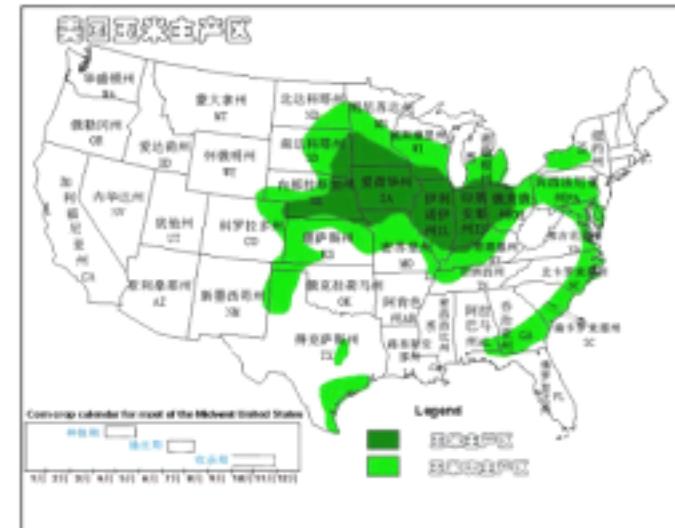


# 1、Weather-27%

P.R.C



USA





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## 2、 Nitrogen-26%

有机肥+秸秆还田

土壤有机质含量：4~6% VS 1%





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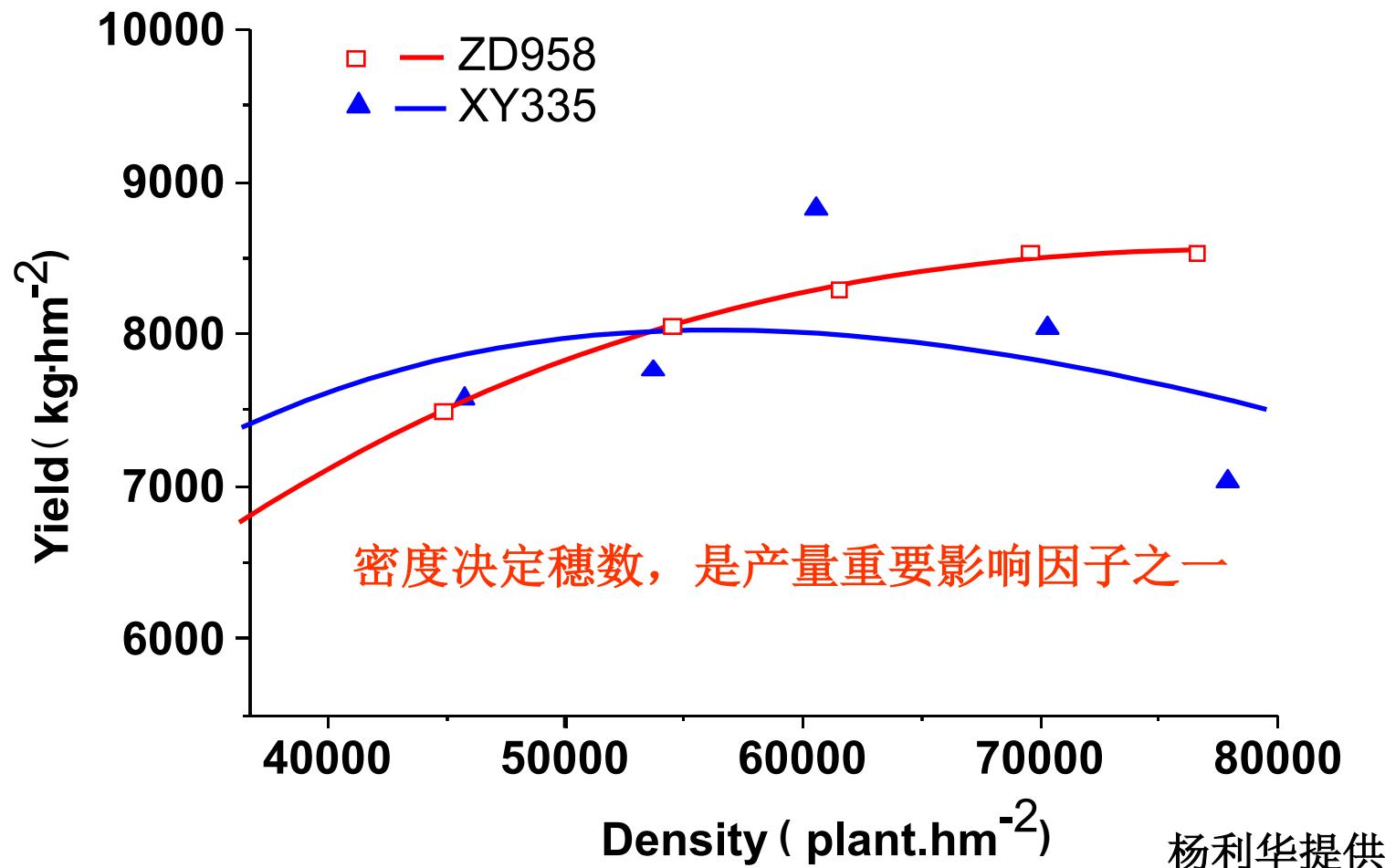
# Results





### 3、Population-8%

3000~3500株/亩 VS 6000-6500 株/亩





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## 4、Tillage-6%



Moldboard  
Plow



Chisel Plow



Mulch Tiller



Disk



Ripper

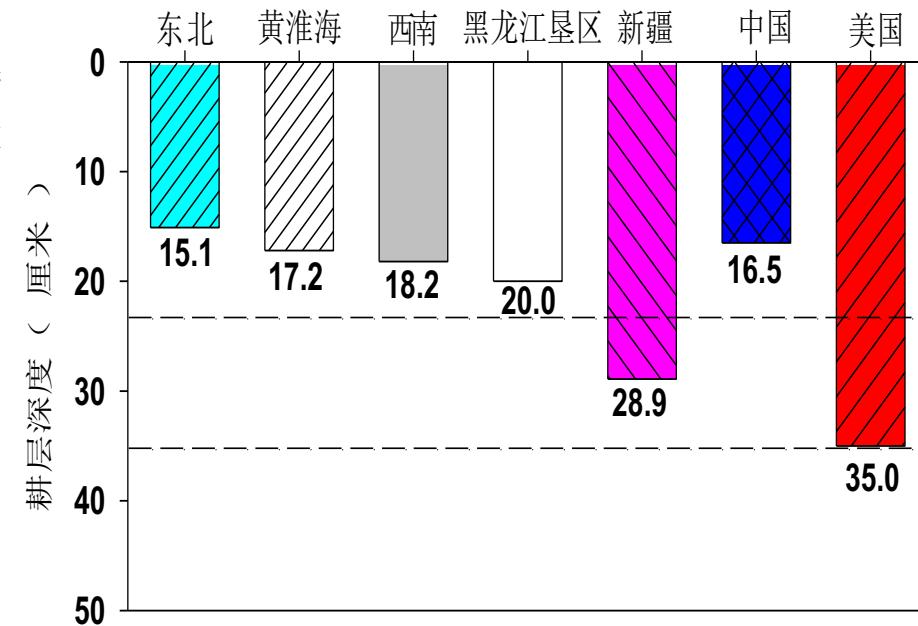


## Soil situation in China

“浅、实、少”

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。

土壤严重板结。作物根系生长发育的适宜容重是 $1.1\sim1.3\text{g}/\text{cm}^3$ 。而全国平均耕层土壤容重达  $1.38\text{g}/\text{cm}^3$

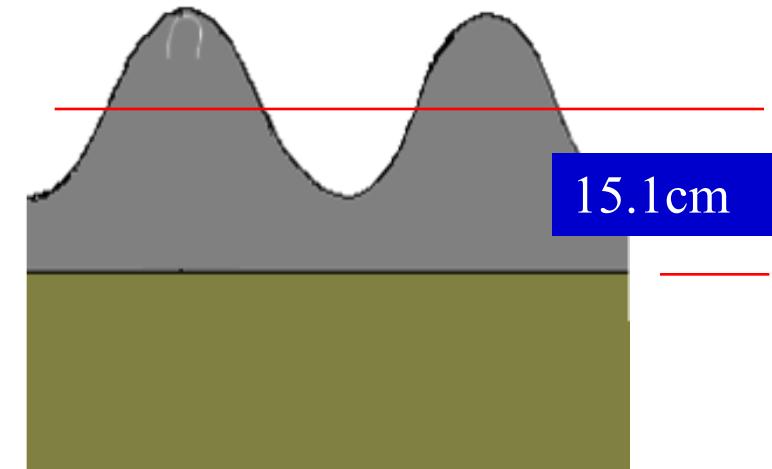




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Hard Pan 6cm-12cm。Bulk density 1.52g/cm<sup>3</sup>  
严重影响作物根系生长发育。





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以深松为主，松整结合+  
秸秆还田的耕作模式



玉米根系沿土壤缝隙生长





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振动深松施肥机





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苗期深松结合施肥作业进行，  
一次进地完成两项作业。





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## 5、Plant

How to plant corn after wheat harvesting?

This is a problem for 2 crop a year area





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## Move straw out of fields manually





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## Then non-till planter





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## Planter



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



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Or burn straw in fields directly





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# Problems caused due to straw burning in fields

Air pollution and fire disaster





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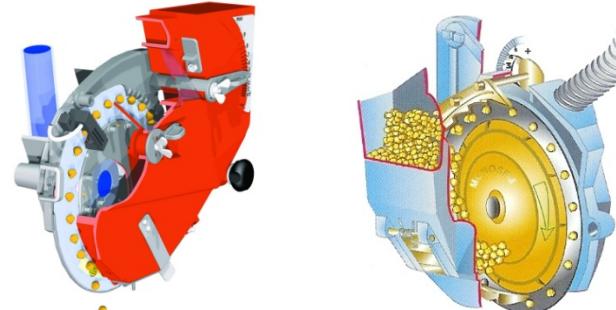
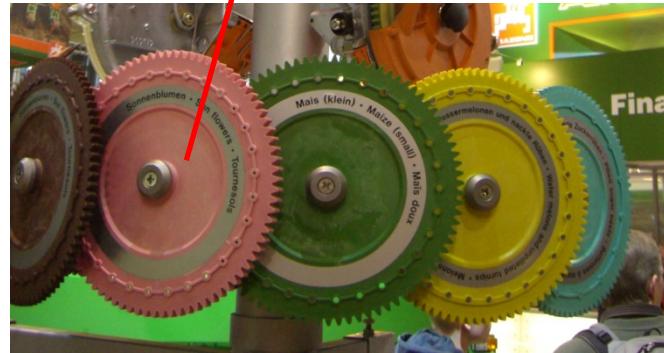
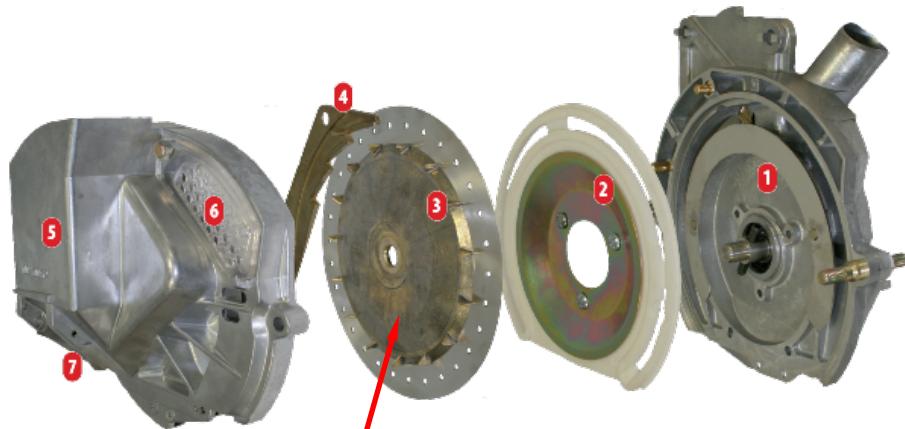
## interplant by hand or a single row planter





## Vacuum 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。



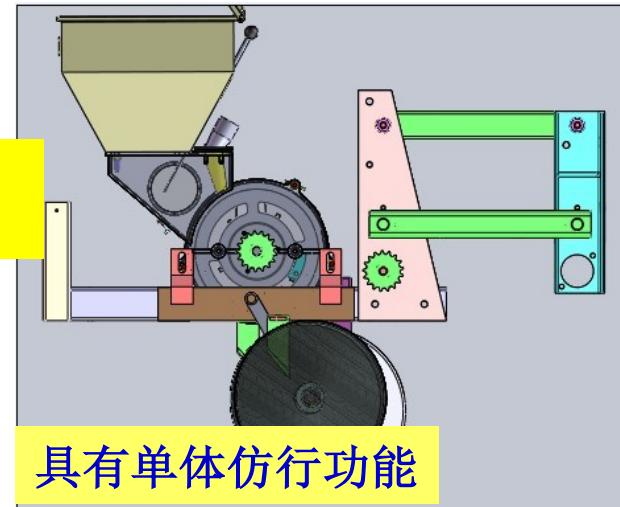


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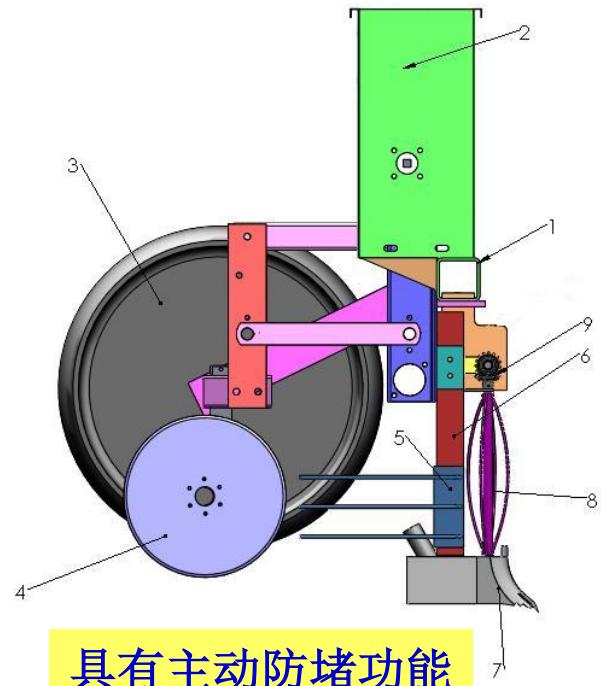
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## Blowing type of Non-till precision Planter

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



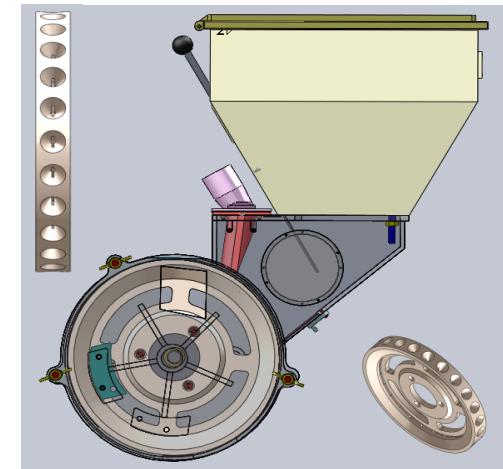
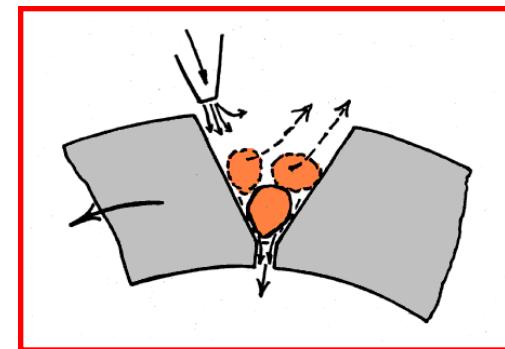
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## 气吹式排种器

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。

适应东北垄作区的大型气吹式播种机





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# Non till or Precision planter with fertilizer application in north areas



Residues decomposed



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## 6. Management





## 7. Corn harvesting

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

1. Row space different
2. Too many varieties
3. Different agronomy systems
4. Planting random



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## Head changeable corn picker





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## Self propelled corn picker & Husker

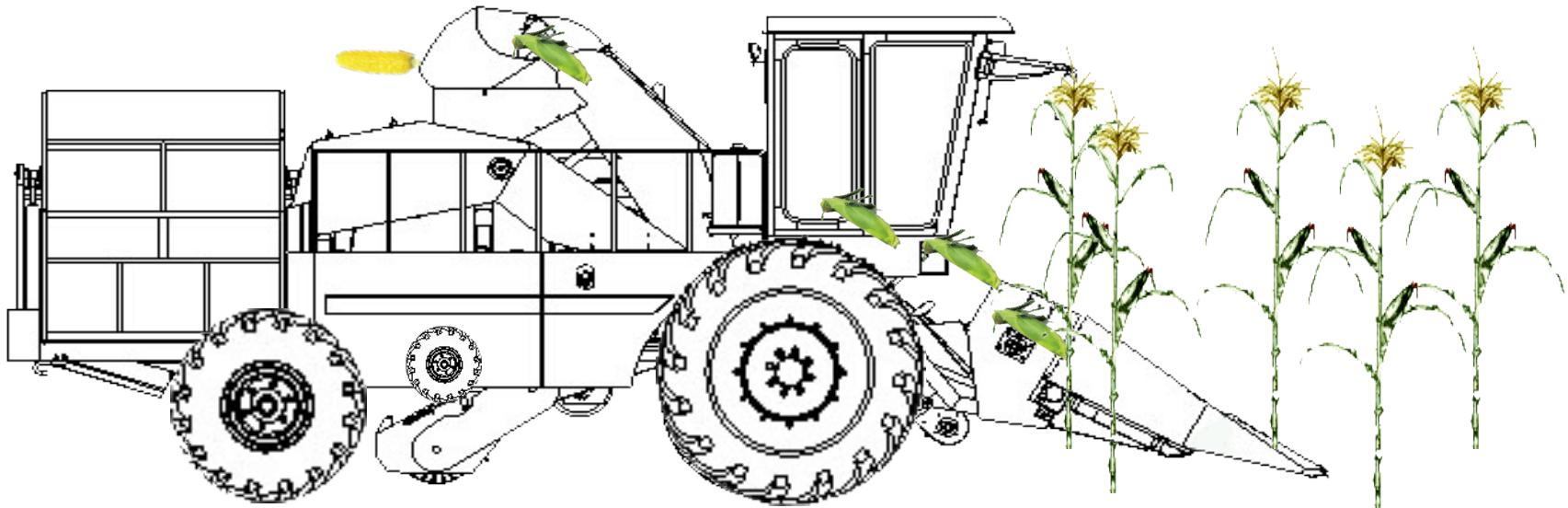




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## 玉米联合收获工作原理





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# 茎杆铺放式玉米收获机



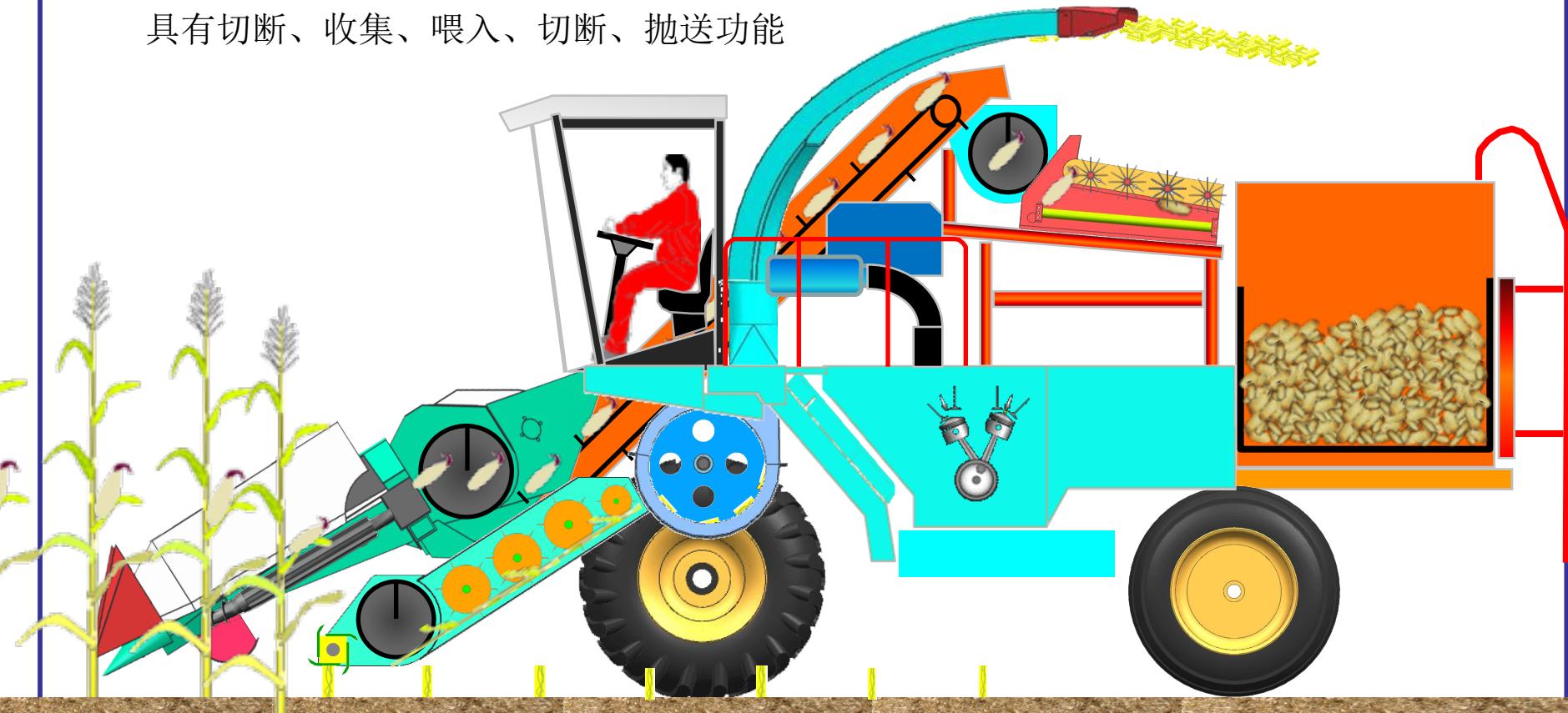


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# 穗茎兼收型玉米收获机

具有切断、收集、喂入、切断、抛送功能





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## Different planting way & style





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Row space 30cm, 40cm, 50cm, 55cm, 60cm, 65cm,  
70cm, 90cm





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## 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。



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行距的不统一对机械化收获而言，不仅增大了作业难度，降低了机器生产效率，而且增大了收获损失率。



小窄行及全喂入式是发展方向吗？

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。



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## Solution in future

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

*Breeding Crops to Suite Machinery*



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## 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)

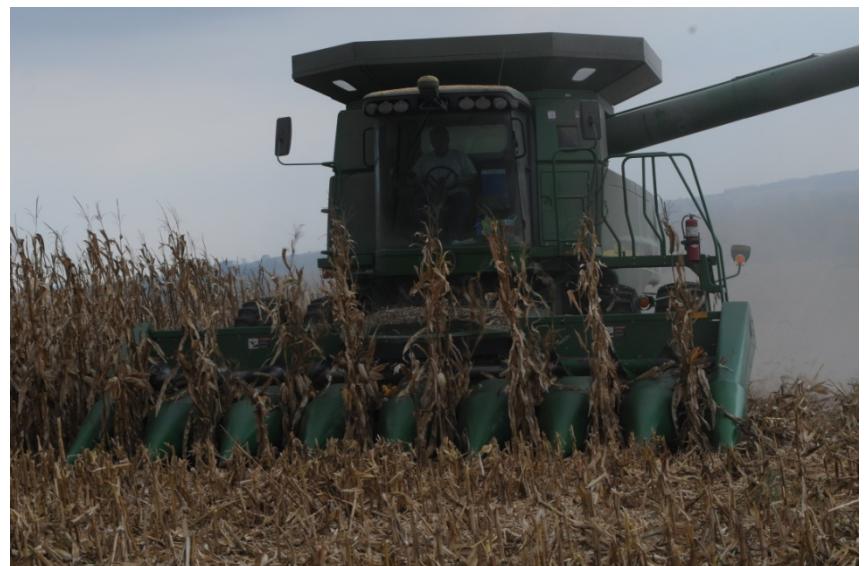




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## 国外直接脱粒收获





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## Wheat Planting

- Wheat plant area 23 million ha (101.8 million t output)
- 80% planed & harvested by machine





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## Wheat harvesting

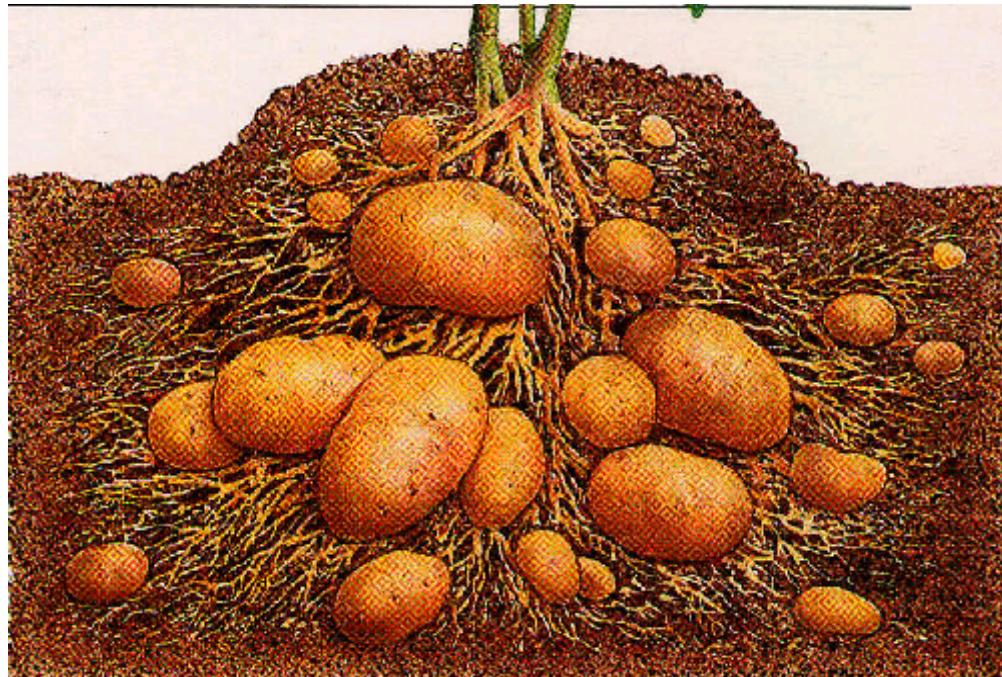




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## Potato production





## 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)

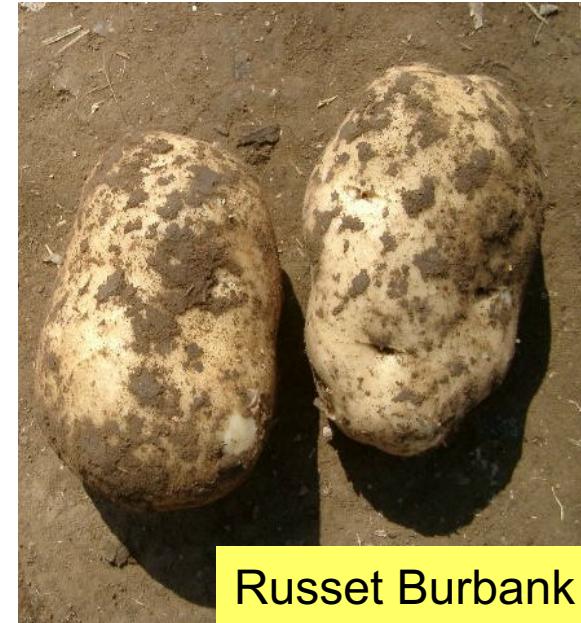


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Atlantic



Russet Burbank



美国薯条



## Tree harvesting seasons





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## Seeds Flow Chart:

Plantlets → Generation 0 → G 1 seeds → G2 seeds

Greenhouse Growing;  
Store 6-9 months at  
least

In Seeds Farm;  
Store 6 months

In seeds  
farm or  
contract

G3 as Chip-stock  
For PC  
production or  
Storage





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## Mini-Tuber

G0 Seeds for continuous Growing to the G1 seeds





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# Planting-Seed Treatment-滑石粉(Talcum) + Topsin

**Warm up after 3-6 month storage-dormancy**





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## Proper field management





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## Diseases & insects control



Bacterial wilt



wire worm





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early/late blight



late blight



early blight



Tubers affected by late blight after a week storage



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Proper irrigation is important



IBS



## Quality control





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## Health Growing:

---Potato Flower

--- Growing time: 90 days to 110 days





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Top by hand



This operation is needed and very important for 2-crops a year areas

Haulm topper





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Just wait for enough mature in 1 crop a year area





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# Manual harvesting





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# Shovels

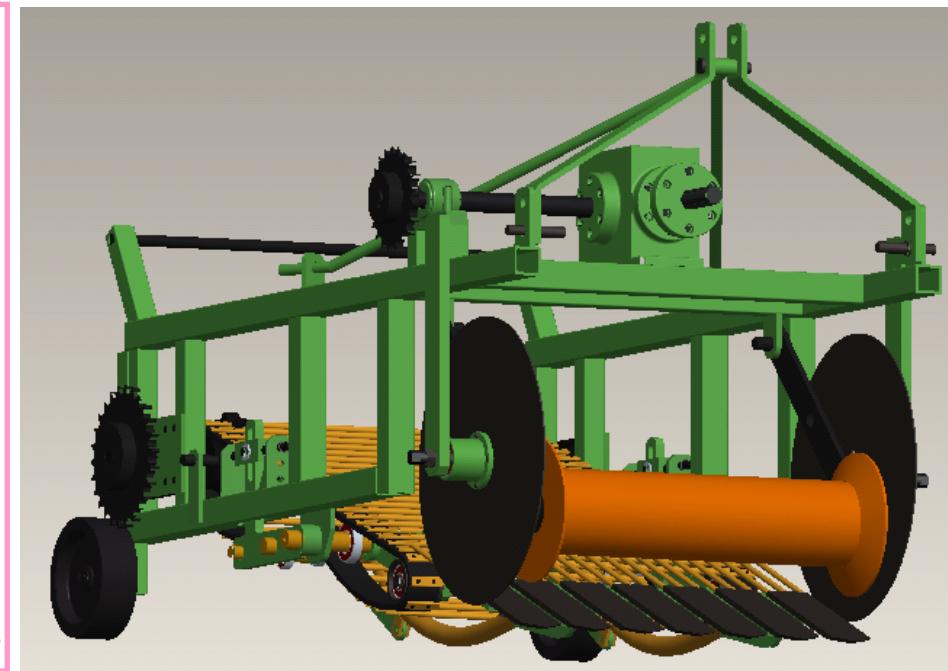
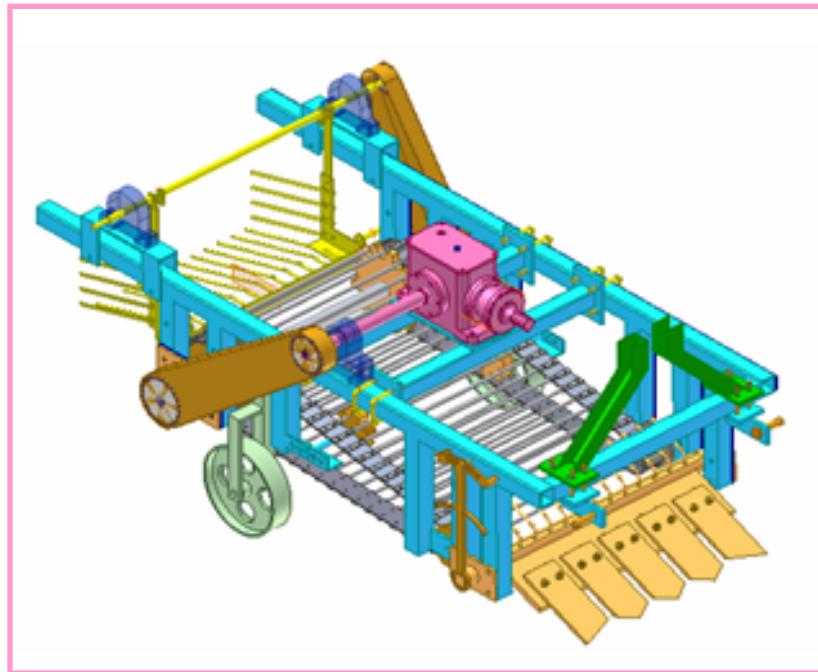




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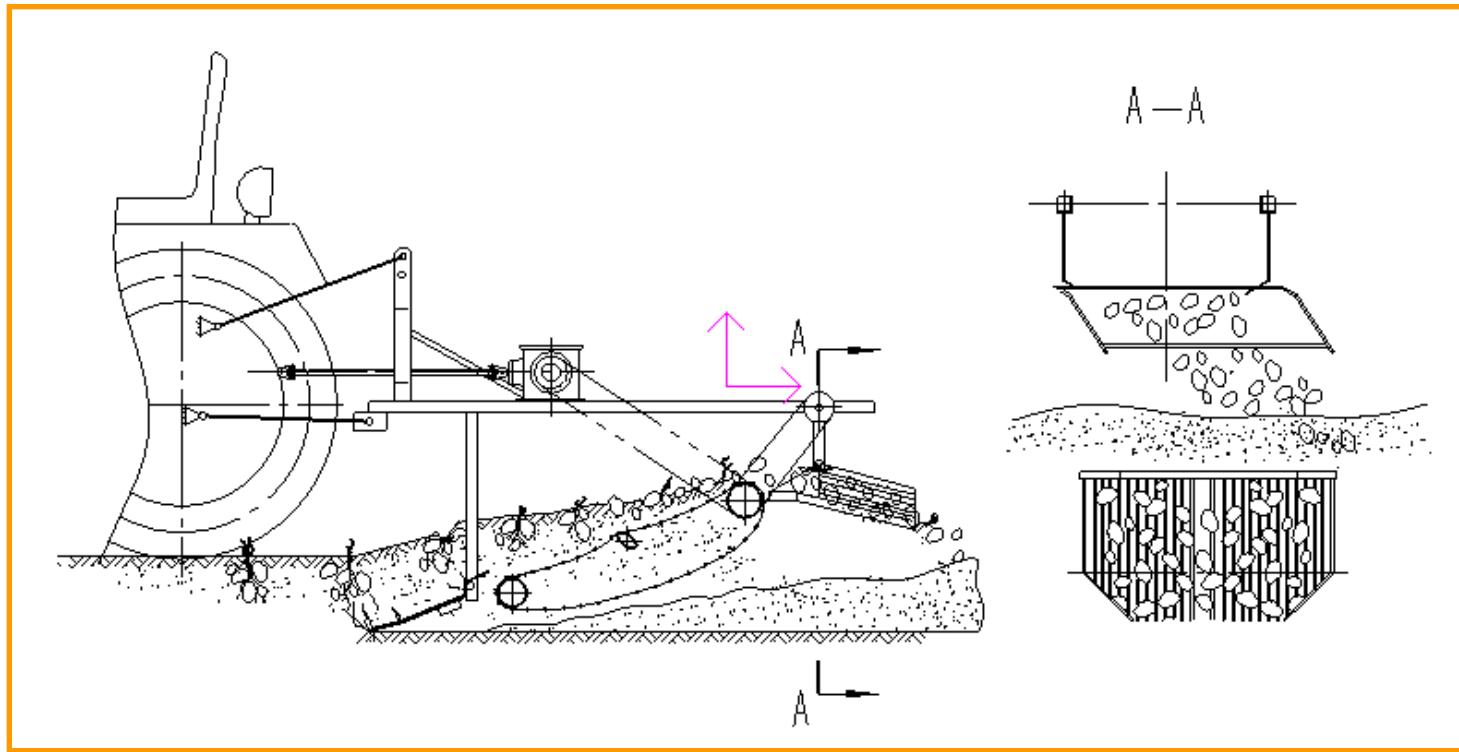
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## ➤ Structure of a digger





## ➤ Harvest flow by diggers



挖掘铲 → 升运链 → 振动筛 → 铺放 → 人工捡拾



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## Small diggers





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## Picking, sorting and shipment





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## Combine harvest and cleaning, shipping





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## Potato Bulk Loading

### Benefits:

1. No Potato shipping damage
2. Bulk Storage for long time store
3. Quickly loading & unloading





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## One Kind of Unloading System





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## 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



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Enjoy the  
good quality  
chips and fries





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## Flake—Artificial Fabric Chips





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# Questions & Discussion



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# Thanks!