Asian and Pacific Workshop on Whole-Process Mechanization of Potato Production

Research and Development Current Situation of Potato Harvest Technology

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- ◆ Profile of potato in China

- ◆ Potato planting patterns and harvest machinery

- ◆ Main research results

- ◆ Constraints and challenges

- ◆ Advice and prospect

1 Profile of potato in China

◆ Potato is main food crops in China, its planting area, total output and exports are the highest in the world. Potato is one of important sources of foreign exchange income in China.

◆ Compared with other food crops, the level of mechanization technology is low.

1 Profile of potato in China

◆ Potato harvester is mainly piecewise (respectively) harvester or half mechanization harvester at present.

◆ Potato combine harvest mechanization technology is not mature, low efficiency, poor reliability, and failed to widespread popularization and application.
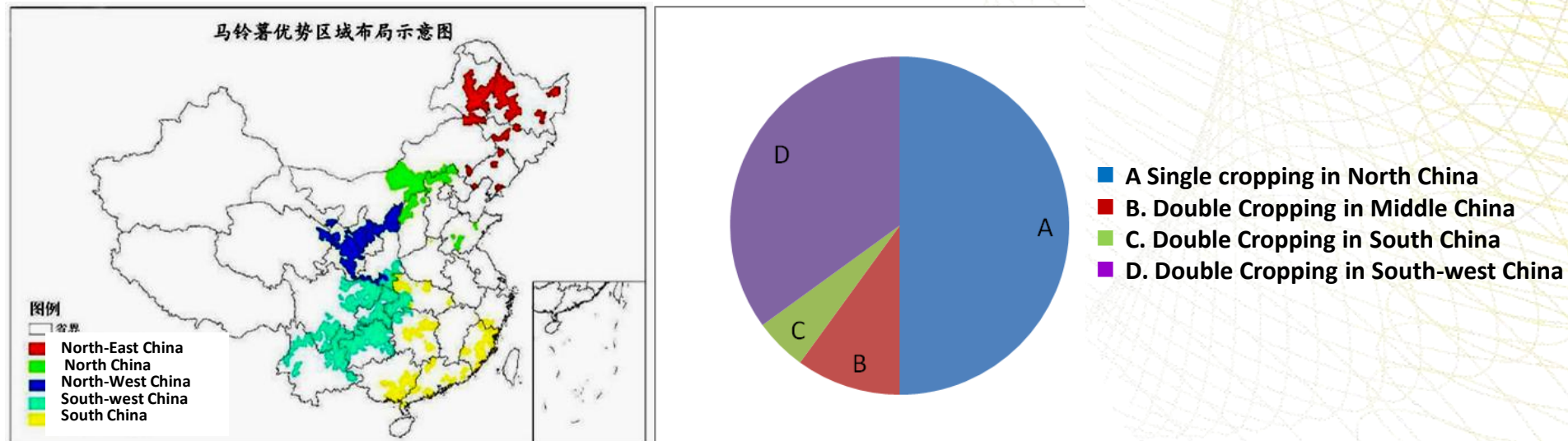
2.1 Potato planting patterns

◆ Complex terrain in China

◆ Different cultivation system of potato

   Advantage region distribution as shown below

图例
省界
■ North-East China
■ North China
■ North-West China
■ South-west China
■ South China

A Single cropping in North China
B. Double Cropping in Middle China
C. Double Cropping in South China
D. Double Cropping in South-west China

2.1 Potato planting patterns

◆ **Represented by shandong**

◆ northeast and north China

◆ northwest china

◆ southwest china

◆ central plains

◆ southern china

➢ Large geographical span, lot size medium

➢ Multiple cropping patterns
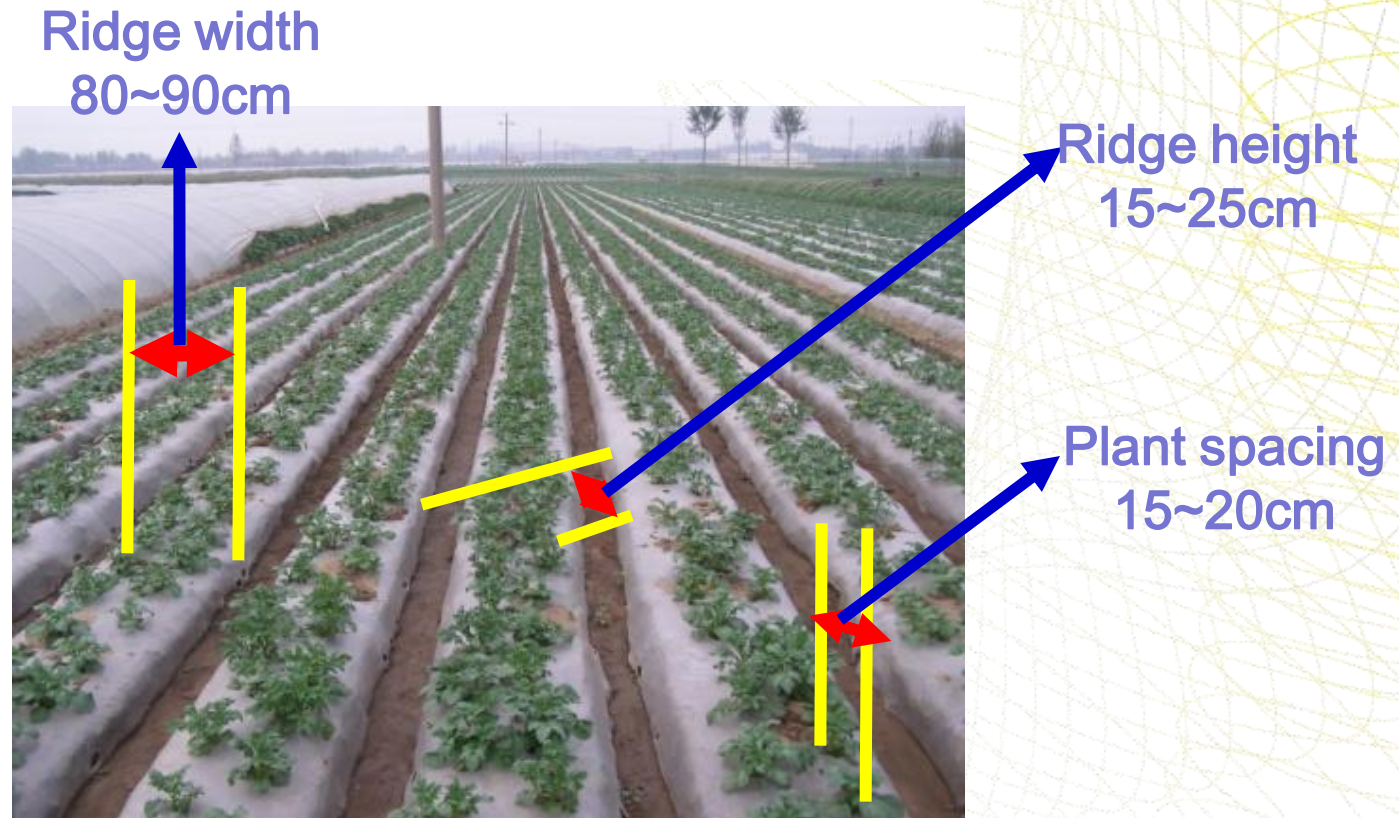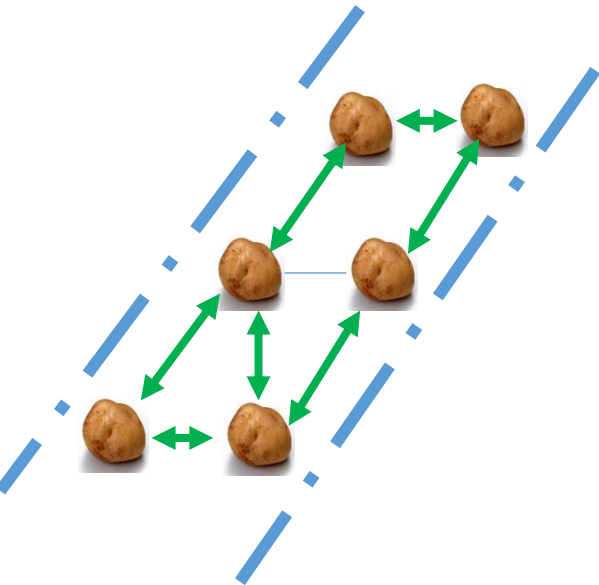
➢ Low level of mechanization

➢ small and medium size machine is required

2.1 Potato planting patterns

Planting characteristics in Shandong province

Ridge width 80~90cm

Ridge height 15~25cm

Plant spacing 15~20cm

2 Potato planting patterns and harvest machinery

2.1 Potato planting patterns

potato harvest process

Processing Storing

cleaning

collecting

carrying

digging

vine cutting

| Preparation | Harvesting | Post-processing |
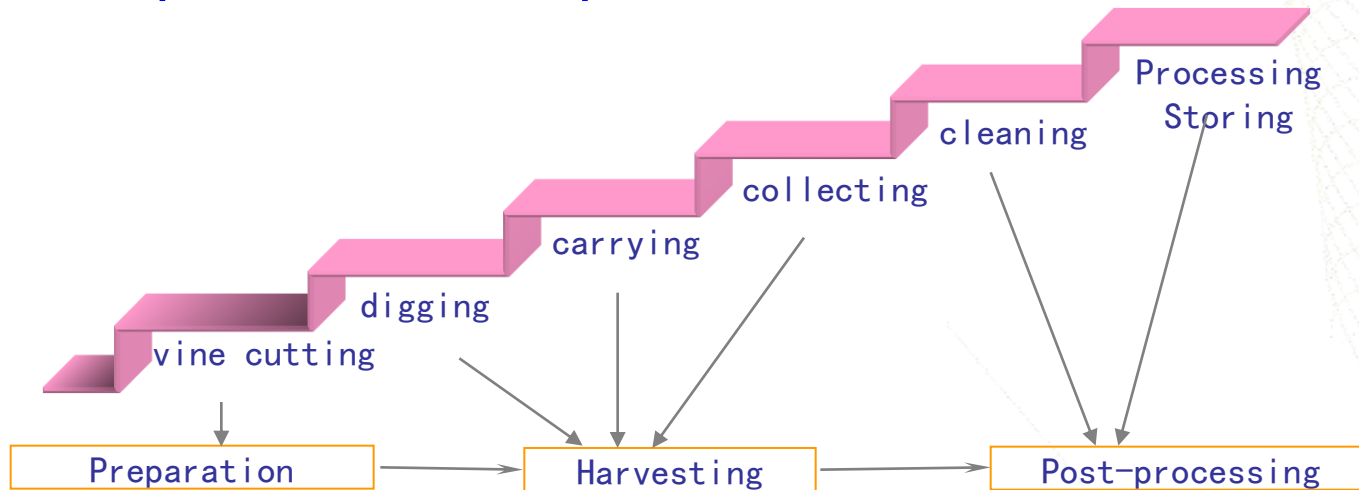
2.2 Commonly Potato harvest machinery

Southwest intercropping area such as Yunnan, Guizhou and southern China such as Hunan, Hubei, Guangdong, Guangxi and other areas, mainly use small potato harvester because of well-known reasons.

2.2 Commonly Potato harvest machinery

Central plains including Henan, Shandong and other areas, using piecewise harvester for the special planting patterns and agronomic requirements.

Slide

2.2 Commonly Potato harvest machinery

Northern China such as Xinjiang, Inner Mongolia and other areas.
Due to vast land, there is high demand for large combine harvester.

3 Main research results

3.1 Research Projects

National 11th Five-year-plan Key Technology R&D Program

"Research and Demonstration of mechanized digging and harvesting Technology"

Special Fund for Agro-scientific Research in the Public Welfare Industry (Agriculture)

"Research on Key Technologies of production mechanization and equipment optimization of root crops"

"Research and demonstration of technology of hilly small farm machinery"

National Natural Science Foundation of China

"Mechanical characteristics of root crops in mechanical mining"

3 Main research results

3.2 Cooperation

Zhongji Meinuo Technology Co., Ltd

Qingdao Hongzhu Agriculture Machinery Co., Ltd

3 Main research results

3.2 Cooperation

Since 2006, Zhongji Meinuo Technology Co., Ltd has been working with Qingdao Agricultural University, completed the national science and technology support project, special funds for agro-scientific research in public welfare industry (agriculture) and other projects.

3 Main research results

3.2 Cooperation

http://menoble.com/

3 Main research results

3.2 Cooperation

Since 2009, Qingdao Hongzhu Agriculture Machinery Co., Ltd with Qingdao agricultural university has been undertaking jointly the special funds for agro-scientific research in public welfare industry (agriculture) and provincial scientific research project, etc.

3 Main research results

3.2 Cooperation

http://www.hznyjx.com/

3 Main research results

3.3 Main research points

Soil properties research

Planting environment research

Planting patterns research

Sowing depth, seeding uniformity survey

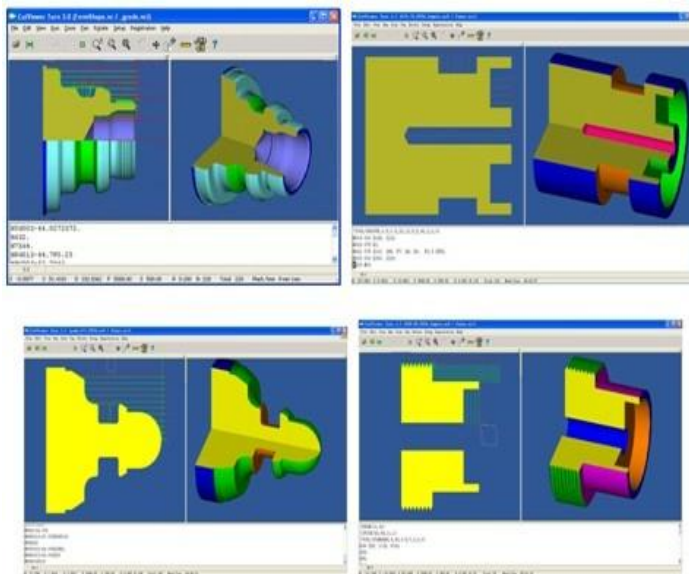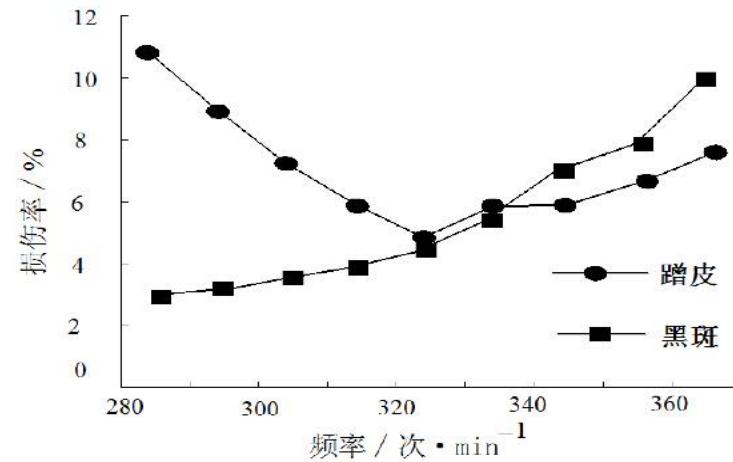# 3 Main research results

3.3 Main research points
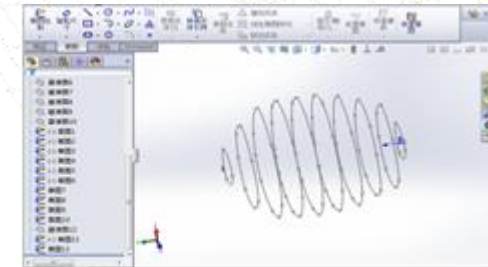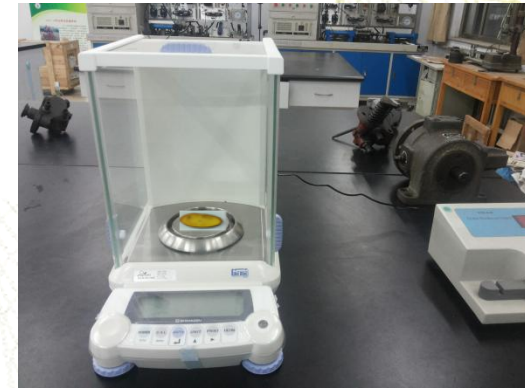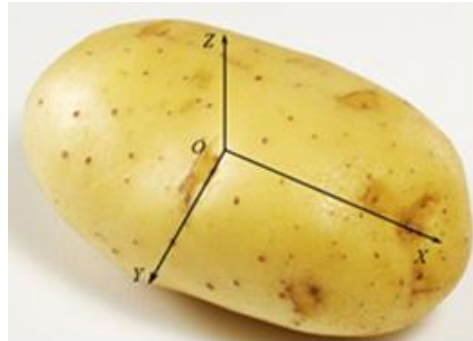
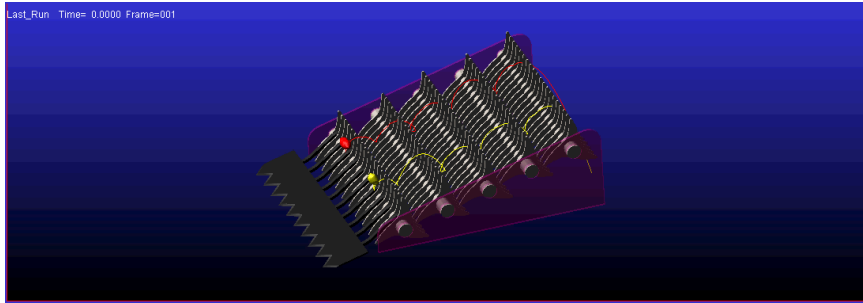Physical properties analysis and model simulation

3 Main research results

3.3 Main research points

Key technology and components of potato field mechanization are analyzed in mechanical properties, and optimize the related parameters.
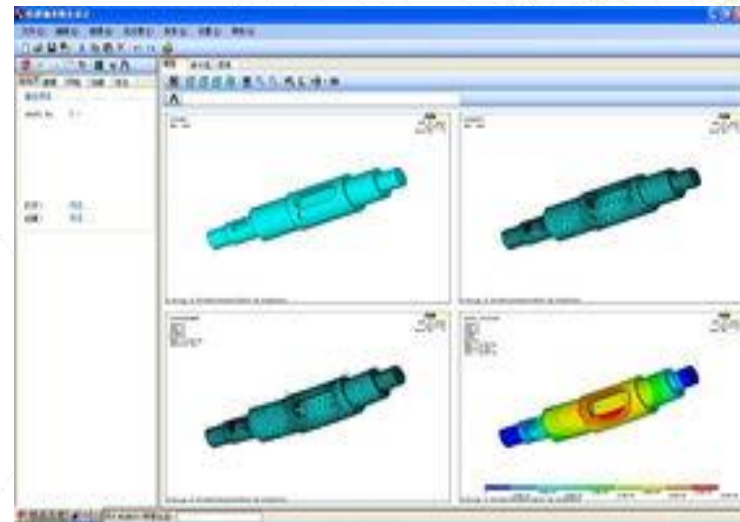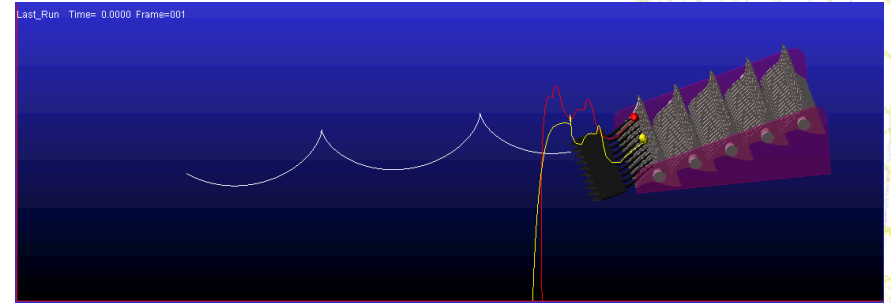
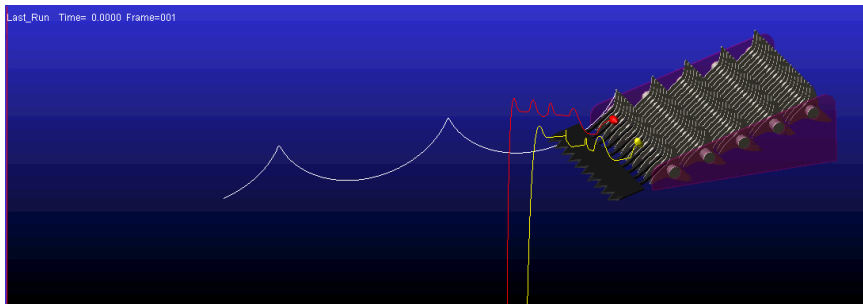# 3 Main research results
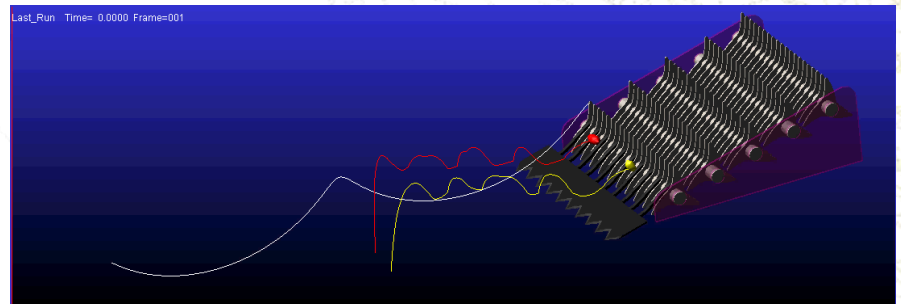
3.3 Main research points

unit still

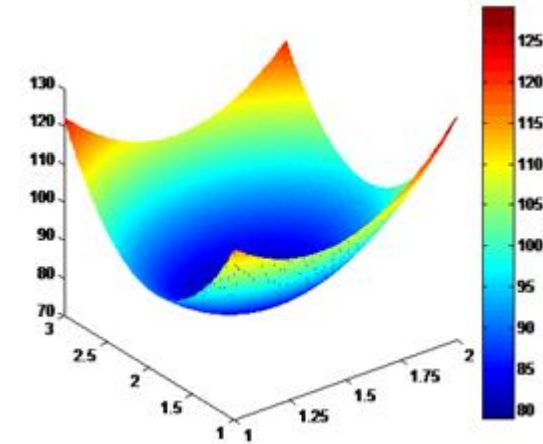proportion of dial tooth and speed is greater than 1

proportion of dial tooth and speed is equal to 1

proportion of dial tooth and speed is less than 1

3 Main research results

3.3 Main research points

$$Y_{min}(z_1, z_2, z_3)=Y(1.3, 1.8, 175)=82.143$$

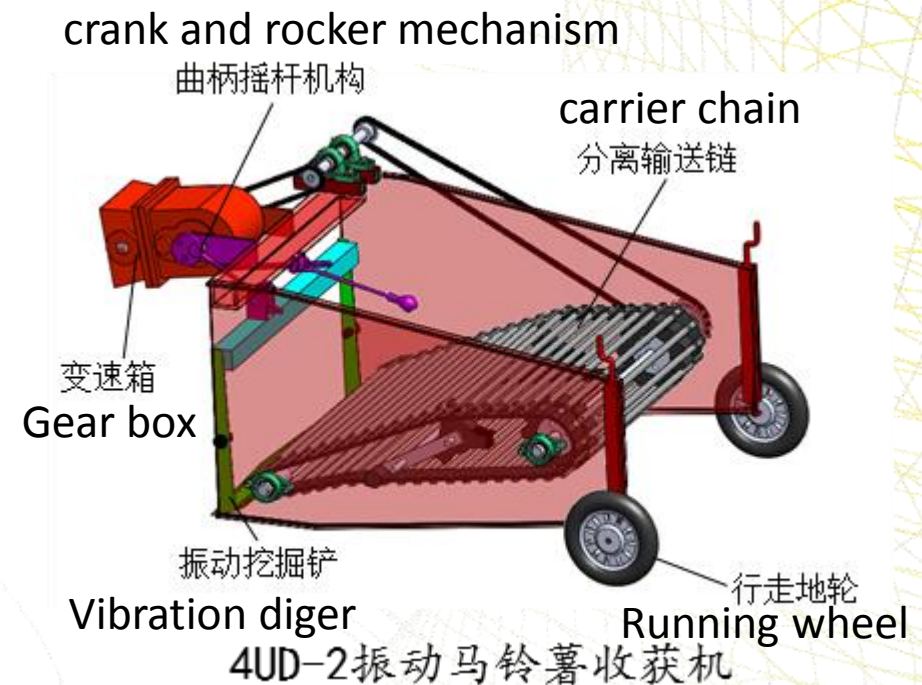**Optimal parameter: Running Speed: 1.3m/s, stir roller speed: 1.8r/s, Height of raising: 175mm**

Runging speed/(m/s)	Stir roller speed/(r/s)	Raising height/mm	Damage area in theory/(mm2)	Damage area in test/(mm2)	Seeing rate of potato/%	Rate of skin damage /%	Rate of damage/%
1.3	1.8	175	82.143	84.02	98.37	1.95	

3 Main research results

3.4 Developed machine

3.4.1 4UD-2 vibration potato harvester

➢ Vibration digging shovel

➢ Breaking soil

➢ Reduce digging resistance

➢ Increase obvious rate of potato

➢ Reduce injury rate of potato

crank and rocker mechanism
曲柄摇杆机构

carrier chain
分离输送链

变速箱
Gear box

振动挖掘铲
Vibration diger

行走地轮
Running wheel

4UD-2振动马铃薯收获机

3 Main research results

3.4 Developed machine

3.4.1 4UD-2 vibration potato harvester

3 Main research results

3.4 Developed machine

3.4.1 Vibration potato harvester

3 Main research results

3.4 Developed machine
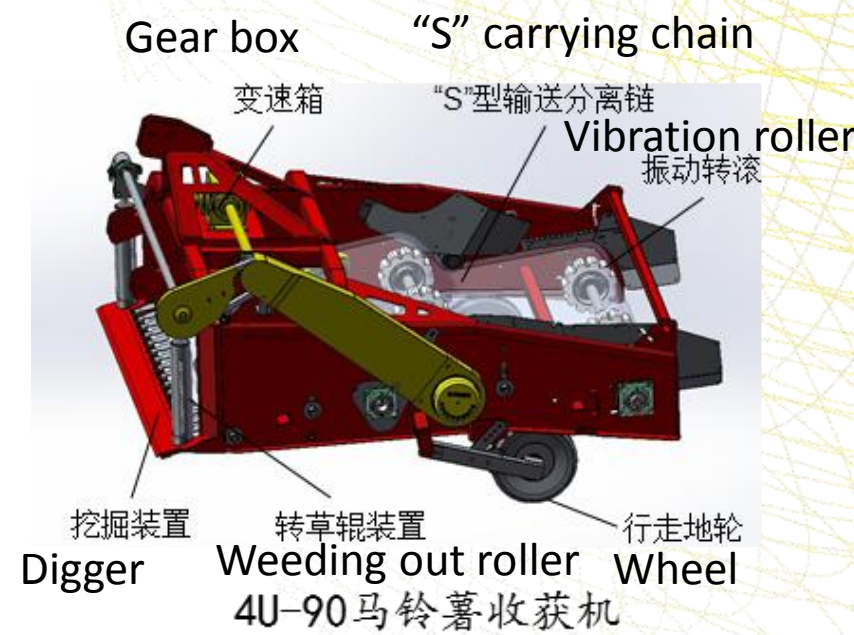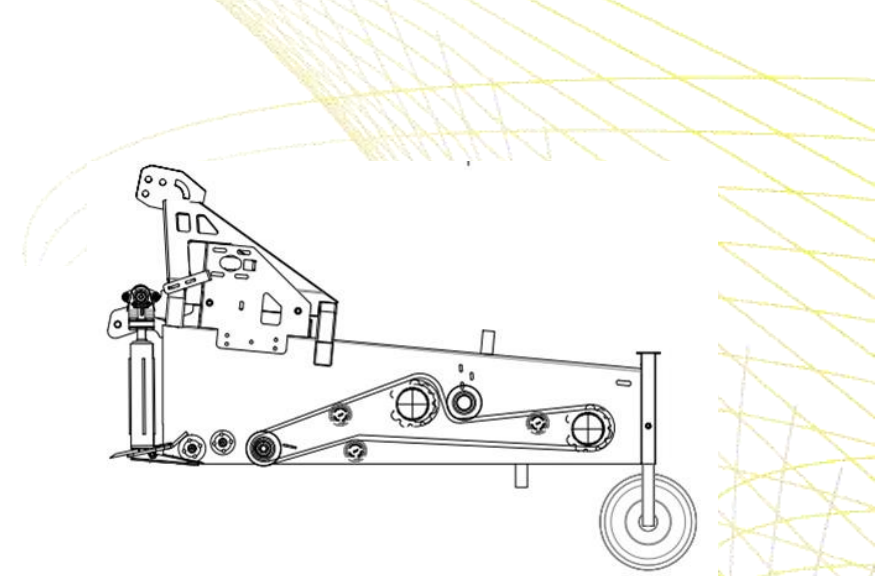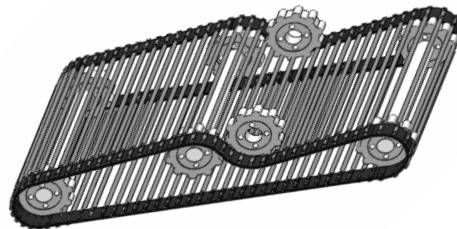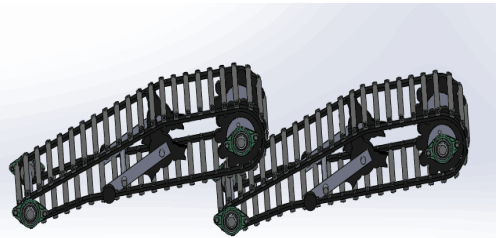
3.4.1 Vibration potato harvester

3 Main research results

3.4 Developed machine

3.4.2 4U-90 potato harvester

➤ **"S" type separation conveyor chain**

➤ **Reduce rate of broken skin**

Gear box   "S" carrying chain

变速箱   "S"型输送分离链

Vibration roller

振动转滚

挖掘装置   转草辊装置   行走地轮

Digger   Weeding out roller   Wheel

4U-90马铃薯收获机

3.4 Developed machine
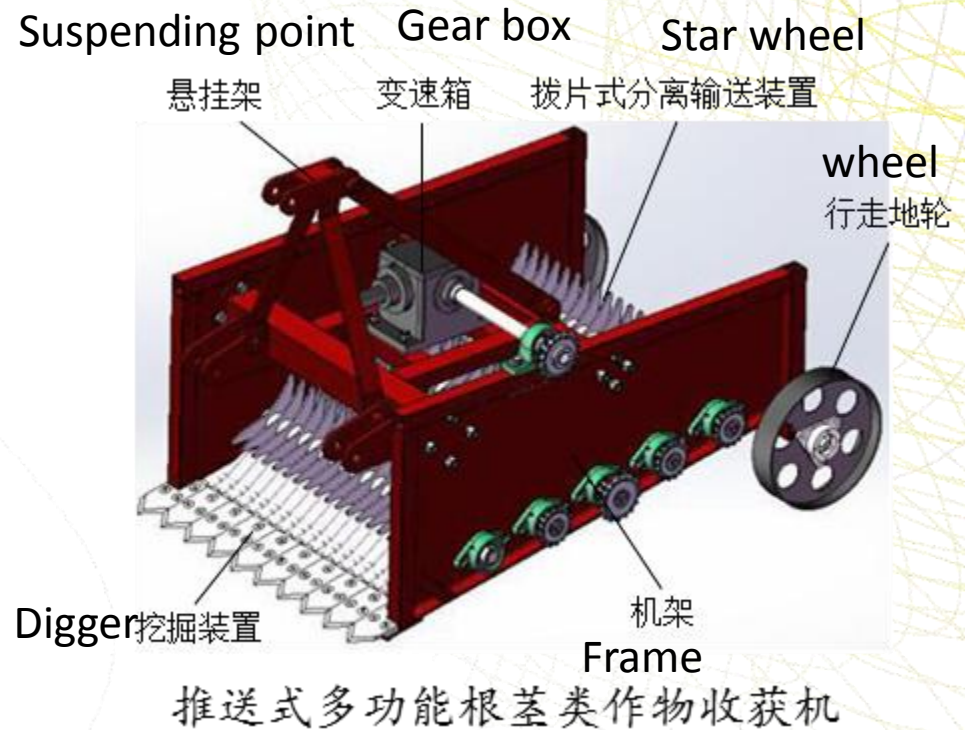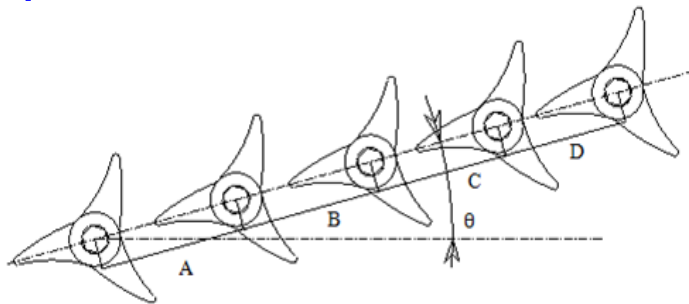
3.4.2 4U-90 potato harvester

3 Main research results

3.4 Developed machine

3.4.3 Star wheel type multi-function root crops harvester

- Star wheel type conveying and separating device
- Staggered arrangement
- Increase separation rate of potato and soil

Suspending point   Gear box   Star wheel

悬挂架   变速箱   拨片式分离输送装置

wheel

行走地轮

Digger 挖掘装置

机架
Frame

推送式多功能根茎类作物收获机

3 Main research results

3.4 Developed machine

3.4.3 Star wheel multi-function root crops harvester

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

- ➢ Hydraulic deep limiter
- ➢ Flexible separation device
- ➢ Hydraulic fruit collecting device
- ➢ Intelligent monitoring device
- ➢ Reduce loss
- ➢ Improve working efficiency

3 Main research results

3.4 Developed machine

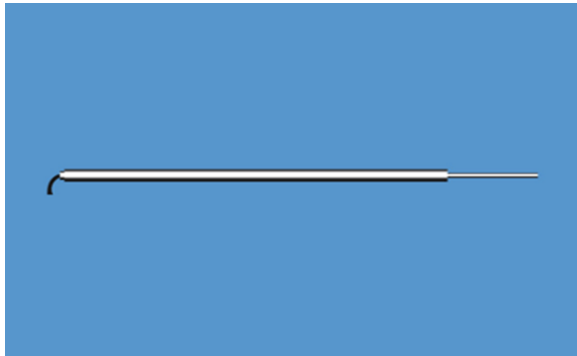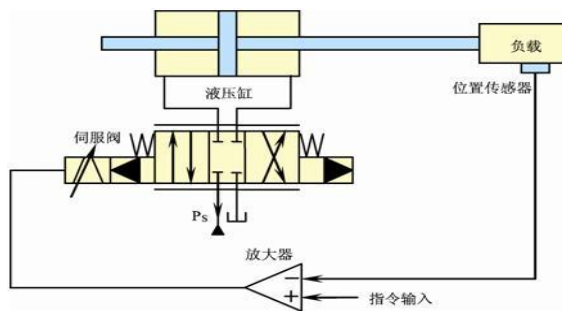### 3.4.4 1710A potato combine harvester

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

LVDT Displacement Sensor

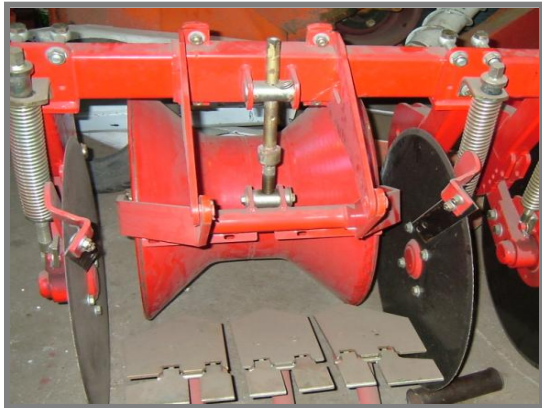Hydraulic Control System

➤ **Hydraulic deep limiter**

Focus on mechanical sensor combined with enclosed electro-hydraulic steering automatic control technology

To realize automatic combine operation of accompanying guidance

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

Change connection mode and structure

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

➢ Flexible separation device

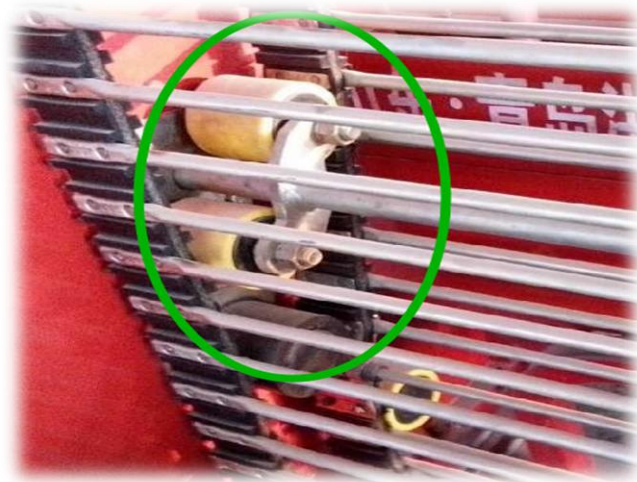Electrohydraulic combined chain conveyor separation technology

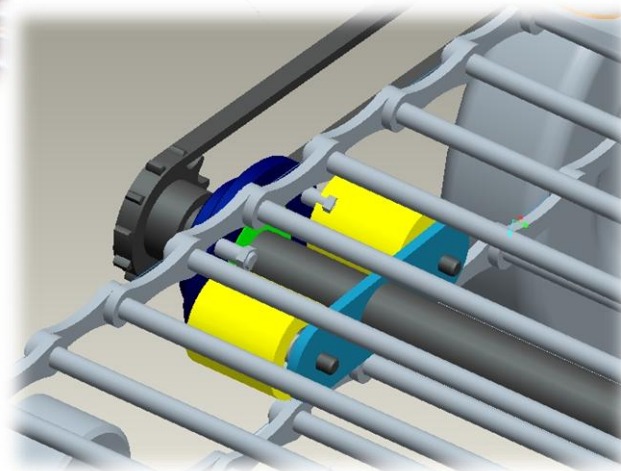Control technology of vibration security separation

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

Floating shake soil vibration technology

Technology and device of vibration soil cleaning
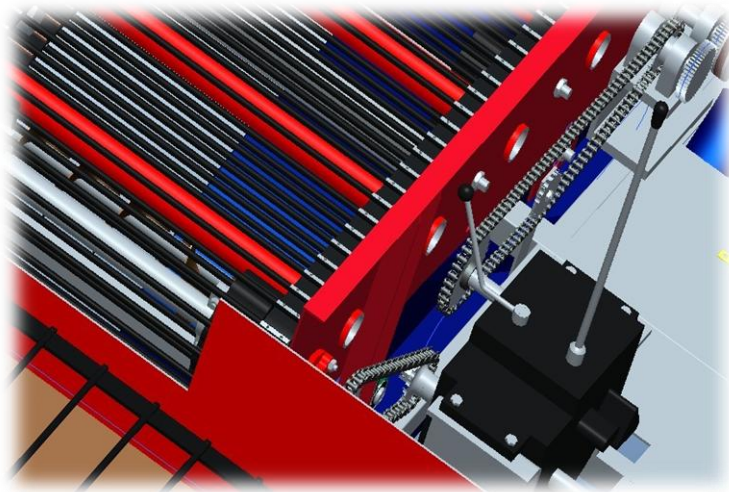
Optimizing vibration cleaning mechanism

Adjustable vibration parameters

Improving the effect of soil cleaning and reducing the skin damage of potato

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

Multistage transmission

To cope with the requirements of harvesting in different soil

The conveying chain can be adjust at different speed with the multi-step gear box

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

➢ **Hydraulic fruit collecting device**

Radar ranging induction control feedback

Accurate positioning, decrease injury rate of potato and realize switch quickly and accurately
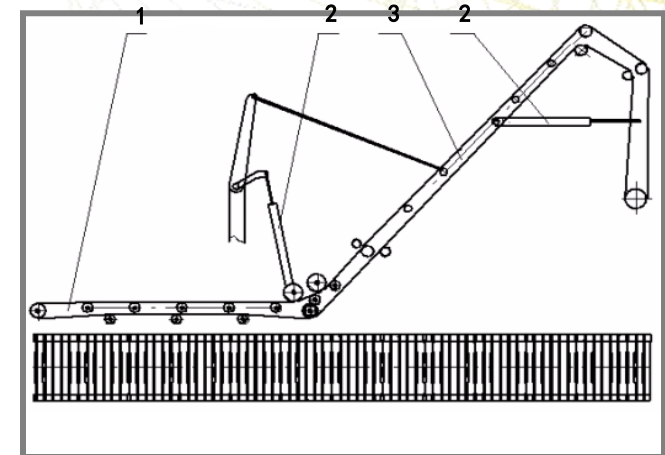
HJRD83 radar material level meter

3.4 Developed machine

3.4.4 1710A potato combine harvester

◆ Further separation of potato and soil

◆ Hydraulic control, stable and reliable operation

Elevator loading parts

1. Side output 2. Hydraulic lifting folding structure 3. Elevator chain

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

➢ **Intelligent monitoring device**

Intelligent monitoring device

- Focus on research and development of intelligent control and equipment condition monitoring and control device
- Integrated data and information to achieve automatic control and precision processing in process of potato combined harvest
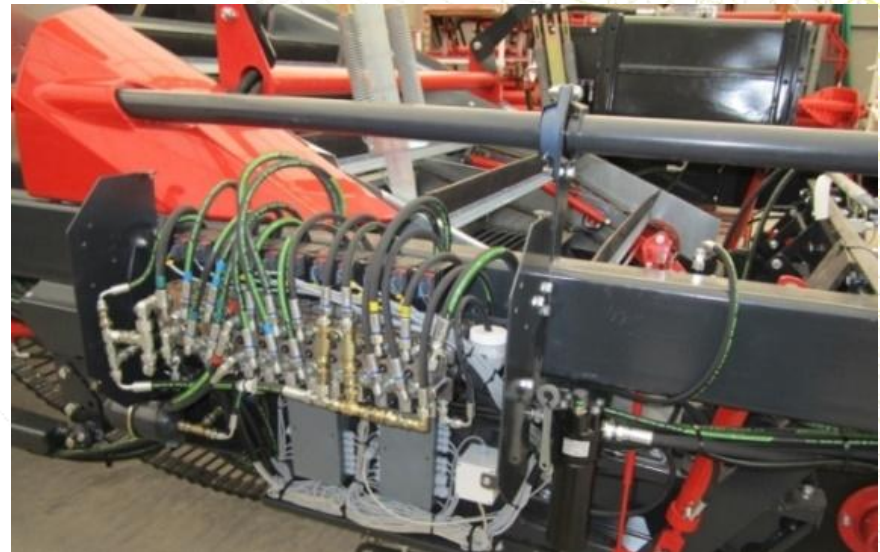
3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester

Make up for current situation of less application of mechanical and electrical hydraulic integration technology in potato combine harvester
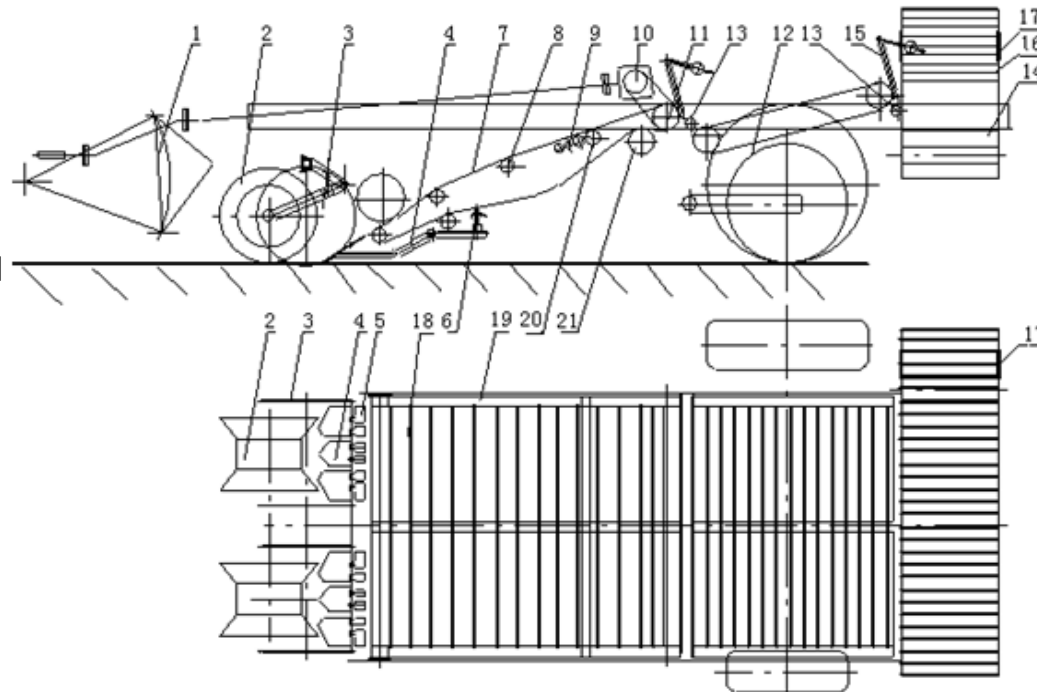
3.4 Developed machine

3.4.4 1710A potato combine harvester

1.Suspending frame
2.Depth roller 3. cutter
4. digger 5. guard board
6. Depth Adjusting
screw 7. carrying chain
8. carrier roller 9.
vibration roller 10.
mechanical drive
system 11. drive wheel
12. Running wheel 13.
stem roller 14. side out
put

15.Pressing grid bars 16. lift carrying chain 17. Hydraulic folding mechanism 18. Steel grid bars 19. rubber belt 20. adjusting roller of vibrating amptuder 21. Driving wheel

1.牵引架 2.镇压限深轮 3.圆盘刀 4.挖掘铲 5.护板 6.深度调节丝杠 7.输送链 8.托轮 9.抖动轮 10.传动系统 11.输送链驱动轮 12.行走轮 13.排茎辊 14.侧输出 15.拦压栅条 16.升运链 17.液压升降折叠机构 18.钢栅条 19.胶带 20.振幅调节轮 21.副驱动轮

3 Main research results

3.4 Developed machine

3.4.4 1710A potato combine harvester
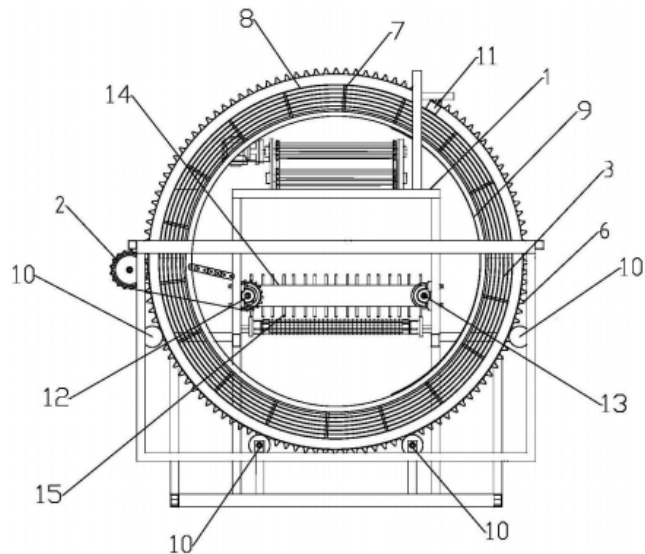
3 Main research results

3.4 Developed machine

3.4.5 Round sieve type potato harvester

➢ Annular separation sieve

➢ Increase obvious rate of potato

➢ Reducing impurity rate

3 Main research results

3.4 Developed machine

3.4.5 Round sieve type potato harvester

3 Main research results

3.5 Demonstration and promotion

➤ Jiaozhou demonstration area in Shandong

province has been established

Demonstration area of 50 mu

➤ Address：Jiaozhou jiaolai town

Dazhaojia Village

3 Main research results

3.5 Demonstration and promotion

October 26-28, 2015, Qingdao Jimo international expo center, "China international agricultural machinery exhibition (2015)"

3 Main research results

3.5 Demonstration and promotion

October 26, 2015 afternoon, Qingdao jimo Dianji town, "Sowing and ploughing" agricultural mechanization solution demonstration activities.

3 Main research results

3.5 Demonstration and promotion

June 30, 2015, Jiaozhou potato production mechanization demonstration base in Shandong province, Mechanized harvesting attendant.

Slide
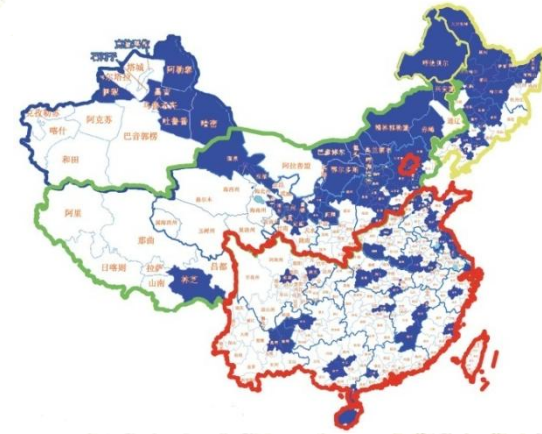
3 Main research results

3.5 Demonstration and promotion

Scientific research results have been application in all over the country.

3 Main research results

3.5 Demonstration and promotion

3 Main research results

3.5 Demonstration and promotion

Results have been successfully exported to Angola, Zimbabwe, Mongolia, Russia, Ukraine, Cuba, Brazil, Argentina and other countries.

4 Constraints and challenges

◆ Problems of collision injury are the most important: more than 40%.

◆ In some viscous soil areas, combine harvesters had been challenged, potato piece and soil cannot be separated.
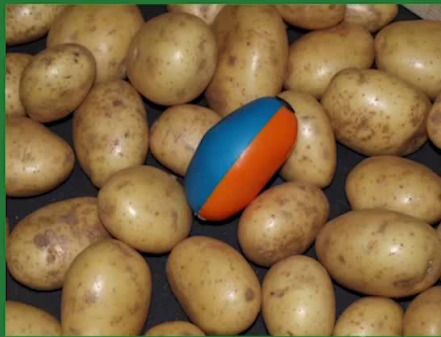
4 Constraints and challenges

◆ Need to improving adaptability and reliability of key components.

◆ Low reliability, high failure rate, injury, high energy consumption and low work efficiency.

5 Advice and prospect

Based on experience of research on electronic potato in British,try to reducing the injury rate of potato.

Thank you for your attention !

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