

Research Team of Mechanized Maize Production

College of Engineering, China Agricultural University



Prof. Zhang Dongxing

The research team of mechanized maize production, based on the support of China Agricultural Research System of Maize (CARS-02) and Key Laboratory of Soil-Machine-Plant System Technology of Ministry of Agriculture (MOA) of China, has closely cooperated with maize industry since 2007 and has achieved fruitful outcomes. The team focuses on the research of precision planting, no-till planting and anti-blocking, low damage harvesting technologies of maize, as well as subsoiling and soil sustainability.

The team is led by Prof. Zhang Dongxing, doctoral advisor and expert of CARS-02, and key team members include Associate Prof. Yang Li, Dr. Cui Tao and 17 postgraduate students (9 of them are doctoral students).

Research Projects: In recent five years, the research team has been undertaking more than 10 scientific research projects financially supported by the government or Ministry of Agriculture, which include the following:

Four projects from National Natural Science Foundation of China: (1) Study on influence mechanism of seed singulation by air flow distribution for a mechanical-pneumatic combined precision seed-metering device for maize; (2) Study on precision seed delivery system for high speed maize planter based on the theory of transporting seeds smoothly in order; (3) Research on mechanism for transplanting tissue culture seedlings efficiently based on taking out a cluster of seedlings; (4) Study on self-adaption ear-picking mechanism based on characteristics of separation between the maize stalk and ear.

Three Special Fund projects for Agro-scientific Research in the Public Interest: (1) Study on building reasonable technical criteria for soil toplayer of irrigable land; (2) Study on building reasonable technical criteria for soil toplayer of dry land; (3) Study on optimization and demonstration of mechanized maize production technology and equipment system.

The team is also undertaking one National Key Technology R&D Program (Study on integration and demonstration of maize no-till planting and fertilizer application critical technologies) and one "948" project of the MOA (Platform construction on intelligent control techniques of precision maize planting).

Academic achievements: In recent five years, sixty-nine papers (twenty-eight were indexed by SCI/EI) and one monograph (Technology and Equipment for Mechanized Maize Production) were published. Twenty-four invention patents were authorized. Moreover, The Instruction of Mechanized Maize Production Technology suggested by the research team has been issued by the General Office of MOA and already in implementation. Four technical innovations proposed by the research team have been listed in the main extension technologies by the MOA, which are: mechanized soil deep loosening technology, mechanized maize precision planting technology, mechanized maize harvesting technology and mechanized maize production technology.

Talent cultivation: In recent three years, ten graduate students received Master's Degree, thirteen doctoral candidates graduated, and seventeen graduate students are studying in the team now.

Research condition: The team has the following facilities in the laboratory to support the research activities on maize production mechanization: A precision seed-metering test bench, a mechatronic planting system, a maize harvest test bench, a soil bin and other instruments with the total value of more than 20 million RMB Yuan.



Group photo of the research team

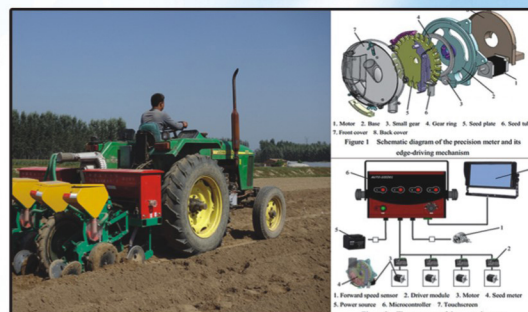


Some patents won by the research team

Main Achievements of the Research Team of Mechanized Maize Production, College of Engineering, China Agricultural University

1. Electrical-driving precision maize planter

Pneumatic precision maize seed-meter driven by electrical motor was developed. A matching intelligent controlling system was also designed combining the monitoring and control technology. A 2BDJ-4 precision maize planter was developed based on above technologies. Spacing between adjacent seeds can be adjusted between 18-35cm on a touch-screen. Planting population, distance, forward speed and planting quality (qualified feeding index, skips, multiples and precision index) can be displayed in time. Planter test organized by China Agricultural Machinery Testing Centre showed that the qualified feeding index (QFI) was 99.3% at forward speed of 10 km/h, while the QFI was 97.2% at 13 km/h.



Electrical-driving precision maize planter

2. No-till precision maize planter

A 2BYJMFQC-4 no-till precision maize planter was developed for North China Plain where the main cropping system is annual wheat–maize double crops. A new pneumatic seed-meter was developed with the cone-shaped cells, which is not sensitive to seed shape and size, and as a result, high planting accuracy can be ensured. Meanwhile, an active parabolic cylinder anti-blocking mechanism was developed to remove residue on seed belt zone. Through the scientific and technological achievements appraisal organized by Ministry of Education, the new pneumatic seed-meter and the active anti-blocking mechanism were considered to reach international leading level.



No-till precision maize planter

3. Vibration subsoiler

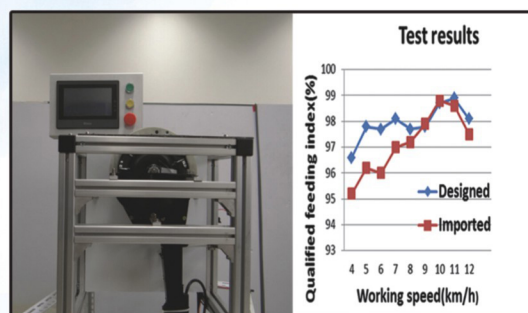
A1SZ-460 vibration subsoiler with eccentric shaft vibration generating mechanism and improved subsoiler shank was developed. It has the benefits of reducing the traction resistance from 7% to 17%, enhancing the efficiency of operations from 11.1% to 16.2% and improving the effect of loosening soil. Through the scientific and technological achievements appraisal organized by Ministry of Education, the vibration subsoiler was considered to reach international leading level.



Vibration subsoiler

4. Test stand for seed-meters

A test stand was designed by integrating detection, monitoring and precision seeding technology. The test stand could monitor seeding quality of different seed-meters, including scoop-wheel, finger pick up, vacuum and air pressure seed meters. It is convenient to adjust seed spacing, and displays operation parameters in real-time including seed spacing, forward speed and qualified feeding index. Comparison test showed that the detection accuracy of the test stand is quite close to that of the imported platform from Precision Planting Inc., USA.



Test stand for seed-meters

5. Automated seed soaking and rinsing machine

An automated soaking and rinsing machine was designed for seed treatment. Seeds were soaked in a mutagen tank, an impeller driven by a motor was mounted inside the tank, and liquid level sensors were used to detect the mutagen quantity. The machine could replace the manual works completely to reduce the damage on operator. The time for mixing seeds and chemical reagents uniformly is 30s when the impeller is working at its optimal velocity of 20 r/min. The mechanical damage rate of the machine is 8.1% on average and just 4.2% higher than the manual damage rate (3.7%).



Automated seed soaking and rinsing machine