

Key Technology and Equipment for Mechanized Seeding and Harvesting of Peanut



Prof. Shang Shuqi

The research project of the Key Technology and Equipment for Mechanized Seeding and Harvesting of Peanut started in 2000, which was conducted by the team from Qingdao Agricultural University, Shandong Wuzheng Group Co., Ltd., Qingdao Wan Nongda Peanut Machinery Co., Ltd., Linshu Dongtai Machinery Co., Ltd., Qingdao Hongsheng Auto Parts Co., Ltd., and Henan Haofeng Machinery Manufacturing Co., Ltd. The major researchers of the team include Shang Shuqi, Yang Ranbing, Wang Dongwei, Li Ruichuan, Lian Zhengguo, Yin Yuanyuan, Wang Yanyao, Wang Qinghua, Hua Wei, Liu Junfeng.

Research Background

The project belongs to the field of agricultural mechanization. Peanuts are important economic and oil crops in China, and the mechanization of seeding and harvesting directly affects the stability and development of peanut production. But the lack of technological theory and core technology has led to serious lag in the development of peanut machinery and equipment, which has become the key bottleneck restricting the development of peanut industry in China. Under the support of the National Science and Technology Support Program and other projects, according to the outstanding problems on technology and equipment of peanut seeding and harvesting, the project team has spent 19 years in collaboration to tackle key problems and systematic research, and has realized the innovation of mechanization theory and method, the breakthrough of key technology, the creation of equipment and the wide-scale popularization and application of peanut seeding and harvesting.

Main Research Contents

1. The method of self-weight feeding and seed metering based on the physical properties of peanut and cutting and extruding soil, pulling and folding, picking and harvesting machinery suitable for upright growing peanut were invented. According to the physical characteristics of peanut seeds, the interaction between non-forced seed filling and metering and mechanical structure was analyzed, and the theoretical method of peanut low damage precision feeding was invented and was widely applied in China. Based on the interaction between peanut seedlings-fruits and soil, the mechanism of pull-and-break force for peanut soil separation by cutting and extrusion was revealed. Peanut picking methods adapting to two-step harvesting, half-feeding and full-feeding were innovated. And the method was adopted by more than 90% harvesters in China.

2. The technology system of single-grain and double-grain peanut profiling combined seedling-preserving precision sowing and digging-pulling-dithering with skimming harvesting was established. The 11 key techniques of peanut seeding machinery, such as smooth and precise seed filling inside single and double seeds, mulching soil on film seedling belt and multi-ridge profile modeling combine operation, were pioneered. A machinery technology system of modular, standardized and easy to support joint seeding was formed. Thirteen key harvesting technologies were invented, such as combined clamping of shovel and chain (belt), multi-dimensional elastic swing soil removal, clamping and turning to orderly placement, swing and spiral curved plate-type broken handle picking, L-type chain-type separation and transportation. The technical system of mechanized harvesting for peanuts was established and over 85% of the domestic application is achieved in China.

3. Eleven types of combined seeders, ten types of two-step harvesters and eight types of combined harvesters were developed and applied to meet the different planting requirements of peanut and different planting areas. According to the agronomic requirements of four typical planting patterns peanut in five main producing areas, the solution of peanut mechanized production and supporting machine methods were put forward. The first information inquiry system for peanut mechanization production was constructed in China. "The Guiding Opinions on Peanut Mechanized Production Technology" promulgated and implemented by the Ministry of Agriculture has been formed. Eleven types of large, medium and small peanut combine seeding machines adapted to different planting requirements have been developed. Ten types of peanut harvesters and eight types of combine harvesters adapted to different harvesting requirements and soil characteristics were developed. The technical problems of systematic operation of peanut harvesting were broken through. A simplified and multi segment combined harvesting operation was realized. The application of mechanization technology for peanut-planting adapted to different cropping patterns and characteristics in China has been pioneered. The leading position of home-made peanut machinery was established.

Main Achievements of the Research

Some of the results of the project won the first prize of scientific and technological progress in Shandong Province in 2014 and the excellent innovation team award of China Agricultural Science and Technology Award in 2015. There are 34 patents authorized for invention, 77 patents for utility models, 6 software copyrights, 79 papers published, 1 book published, 3 technical specifications formulated and 9 enterprise standards formulated.



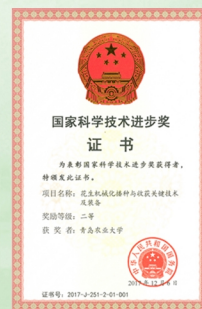
4HYGJ-6, the world's first peanut harvester both peanut and stalks were harvested.



2BMF-4/8 peanut combined planter



Serial peanut harvesting and field management equipment field operations



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Achievements Description

Aiming at the technical bottleneck of peanut seeding and harvesting mechanization, the project invented the methods of self-weight seed metering based on peanut physical properties and cutting, breaking, pulling, breaking and harvesting machinery suitable for upright peanuts through the cooperation of participating units according to the agronomic requirements of main peanut producing areas in China. The technology system of single-grain and double-grain peanut profiling combined seedling-preserving precision seeding and digging-pulling-dithering combined with skimming harvesting as the core was established. Eleven key techniques for peanut seeding mechanization and thirteen key techniques for peanut harvesting mechanization were pioneered. Eleven types of large, medium and small peanut combine seeders were developed, ten types of peanut two-step harvesters and eight types of peanut combine harvesters adapted to different harvesting requirements and different soil characteristics were created, and the solutions of peanut mechanized production in China and the methods of supporting machines were put forward. The first inquiry system of peanut mechanized production information in China was constructed, and the "Guiding Opinions on Peanut Mechanized Production Technology" promulgated and implemented by the Ministry of Agriculture and the "Agricultural Light Simplification Practical Technology" promoted by the Ministry of Agriculture was formed. Twenty-nine new types of agricultural machinery and equipment have passed the performance test of agricultural machinery test and appraisal conducted by above the provincial level. Twenty types of agricultural machinery products have been listed in the catalogue supported by the state or provincial level.

Economic and Social Benefits

The twenty-nine types of equipment developed have passed the test of the national or provincial appraisal. Nine types have been listed in the government procurement catalogue of agricultural machinery products supported by the state and eleven types have been listed in the provincial catalogue. The equipment has become the leading model of National Popularization and Application. During the past three years, 101,805 machines have been sold, with a cumulative operating area of 90.6693 million Mu (1 Mu = 667 m²), a new sales volume of 602 million RMB Yuan, a new profit of 108.35 93 million RMB Yuan, a new tax of 102.3393 million RMB Yuan, a total of 13.384 billion RMB Yuan in operation and application savings. More than 15,000 agricultural technicians have been trained and 79 PhD and master students have graduated to contribute greatly for realizing the whole process mechanization of peanut production and improving farmers' income.

Prospects for Future Application

The implementation of the project has greatly enhanced the technological support capability of peanut industry in China. It breaks through the key technical bottleneck of peanut mechanized seed harvesting, promotes the collaborative innovation of the whole peanut industry chain, speeds up the industrialization and standardization process of peanut machinery and equipment, and promotes the comprehensive competitiveness of the agricultural machinery and equipment industry and peanut industry. In the future, localization of peanut production mechanization technology will become the dominant, and the universal application of peanut machinery and equipment in China will be gradually realized, and farmers' purchase enthusiasm will be greatly improved.

Supported Projects and funds



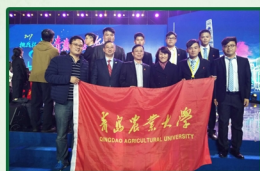
Li Weiguo, Director of Agricultural Mechanization Department of the Ministry of Agriculture and Rural Affairs, came to the college to guide the work.



Zhang Jiangting, Member of the Standing Committee of the Shandong Provincial CPC Committee and Secretary of the Qingdao Municipal Party Committee, came to the college to guide the work.



Prof. Shang Shuqi and Academician Luo Xiwen at the exhibition



Grand Prize Team of the 15th Challenge Cup National Undergraduate Curricular Academic Science and Technology, together with leaders of Chinese Communist Youth League.



Professor Shang Shuqi participates in international activities



Prof. Shang Shuqi Hosts the 14th International Symposium on Field Testing Mechanization

1. "11th Five-Year" National Science and Technology Support Plan "Development and demonstration of mechanized mining and harvesting technology" (2006BAD28B06) "
2. "12th Five-Year" National Science and Technology Support Plan "Research and demonstration on harvesting technology and equipment of large scale multifunctional peanut and sugar beet" (2011BAD20B05) ;
3. Public Welfare Industry (Agriculture) Special Funds for Scientific Research Project "Research on key technology upgrading and equipment optimization of root crop production mechanization" (200903053-02, 08, 11) .
4. Shandong Science and Technology Development Plan "Research on key equipment of peanut combine harvest" (2009GG10009039) .
5. Shandong Agricultural Science and Technology Achievements Transformation Fund Project "Demonstration and promotion of key technologies for peanut combine harvester" .
6. Shandong Province modern agricultural industry technology system peanut machinery post expert project (2011-2015, SDAIT-05-022-09) .
7. Shandong agricultural machinery and equipment innovation research and development project.

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