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Modes and Approaches of Promoting Rural Rejuvenation through the Integration of Industry-Universities-Research Institutions

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Abstract Taking the Zhejiang Academy of Agricultural Sciences as an example, the modes and approaches of combing industry-universities-research institutions to promote rural revitalization by agricultural scientific research units are discussed. The main approaches are as follows; focusing on practical technical training to promote the transformation of scientific and technological achievements, transferring scientific and technological achievements to promote the deep integration of basic research, applied research and achievement transformation, and using the agronomist college as a carrier to promote the integrated development of industry-universities-research institutions and promote rural revitalization through systematic personnel training.

Key words Agricultural scientific research unit, Integration of industry-universities-research institutions, Rural revitalization, Mode and approach

1 Introduction

Industrial prosperity is the foundation of rural revitalization. The most important driving force for rural industrial prosperity is the innovation and achievement transformation of agricultural science and technology. With the development of China's economy and society, the demand for high-quality and safe agricultural products by urban and rural residents is also increasing. People who live in cities long look forward to the idyllic mountain forests. This situation places higher requirements on traditional agriculture, and its model and approach require constant innovation. The integration of industry-universities-research institutions has always been considered as an effective model and way to promote the innovation and achievement transformation of agricultural science and technology. However, traditional agricultural scientific research units are generally accustomed to the direct mode from research and development to promotion, and do not pay enough attention to the training of rural agricultural science and technology personnel. In the new situation, how to promote the transformation of agricultural scientific and technological achievements and then help rural revitalization through the cultivation of professional farmers and rural talents is one of the important models worthy of attention. In this paper, based on the examples of Zhejiang Academy of Agricultural Sciences, a preliminary discussion on this situation will be made.

2 Practical technical training and achievement transformation

Suichang County is located in the southwest of Zhejiang Province,

and the county is mainly mountainous. Suichang baked sweet-potato is a traditional famous special agricultural and sideline product with local characteristics in Suichang County. Its appearance is amber, heart-shaped and sweet. However, the original native variety "Zhouong Baipi" of Suichang Baked Sweet-potato has been planted for many years, so it has been degraded, and the yield has been decreased year by year. Besides, the transparency and color have been greatly dropped, and the quality has also been decreased, which seriously affects the yield and processing quality. Therefore, Suichang Seed Processing Center cooperates with Huangshayao Twon Agricultural Technology Station in Suichang County to introduce a new variety "Zhesu 13" bred by the team of Wu Liehong from the Potato Research Laboratory of Zhejiang Academy of Agricultural Sciences, and studies high-yield and high-quality cultivation technology. A comparative test shows that the yield of "Zhesu 13" increases by 14.4% compared with "Zhouong Baipi", and the processing quality is better than "Zhouong Baipi"; the processing yield is 20% higher than "Zhouong Baipi", which greatly improves the processing efficiency of baked sweet-potato. At present, "Zhesu 13" has become the main variety of sweet potato in Suichang County. In the production of raw materials for baked sweet-potato, the potato breeding team of Zhejiang Academy of Agricultural Sciences constantly discusses sweet potato production work with the town and village agricultural technicians, and proposes solutions to outstanding problems in local sweet potato production. The team provides early-stage virus-free seedlings, and carries out precise docking especially in terms of variety selection, pest control, *etc.* The team conducts technical training from time to time, strengthens farmers' knowledge reserves, and provides constructive opinions on industrial planning. From 2016 to 2019, Zhejiang Academy of Agricultural Sciences held several training courses and 4 on-site meetings in Hushan, Jinzhu, Yingcun and other towns of the

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county, and trained more than 300 backbone farmers. It put stress on the training and demonstration of high-yield cultivation technology and processing technology of new varieties, especially the processing technology of baked sweet-potatoes (slips), which has eliminated the geographical limitations of the original roasted sweet-potato consumer market. As early as 2011, the potato team of Zhejiang Academy of Agricultural Sciences and Suichang Golden Food Co., Ltd. started to the process of making fresh-cut strips into roasted dry sweet-potatoes, promoted it in Suichang and the province, soon opened the national market, and formed a certain processing cluster and market size. The main local sweet potato processing varieties "Zheshu 13" and "Zheshu 33" bred by the potato team of Zhejiang Academy of Agricultural Sciences have been widely promoted and applied. At the same time, it has also supported and cultivated Suichang Golden Food Co., Ltd.—a large-scale roasted sweet-potato processing enterprise with the annual output value of more than 10 million yuan, guided and built Yingcun and Longnvfeng Sweet Potato Processing Plant. In the early stage of production and construction, team members went into the sweet potato processing workshop, carefully observed and understood the processing of baked slips, guided the processing technology, and resolved the technical confusion of the processing enterprises. The quality requirements for the processing of roasted sweet-potatoes and the key points of optimizing cultivation techniques have been clarified, and the fresh-keeping technology suitable for storage in simple large cellars and big cellars has been improved, which has promoted the rapid development of roasted sweet-potato industry. A good job of training and experimental demonstration has been done to promote the development of potato industrialization in the province.

With the strong support of Suichang County Party Committee and Government, local agricultural standard specifications for Suichang roasted sweet-potato have been formulated screen and breed good varieties of raw materials, train farmers in a planned way, and build breeding bases of new virus-free varieties, which has ensured the steady improvement in quality of Suichang baked sweet-potato (slips), and the scale of production has been expanded year by year. In recent years, Suichang baked sweet-potato has won many awards and titles such as the Bronze Award of China Agricultural Expo and the Gold Award of Zhejiang Food Expo. More than 20 domestic news media have reported on Suichang baked sweet-potato. Suichang baked sweet-potato is deeply loved by consumers for its natural and pure quality, crystal clear color and unique flavor. In 2019, Suichang County organized the declaration of the "Suichang Baked Sweet-potato Slips" geographical indication, which strongly supports the implementation of local rural revitalization strategy.

3 Applied research and achievement transformation

The development of rural tourism and leisure agriculture is an important measure to achieve the prosperity of rural industries. In recent years, Zhejiang Academy of Agricultural Sciences, while car-

rying out the breeding of new rape varieties with high oil content, high oleic acid and high quality, has also developed rape varieties with many uses. The main stems can be used as seasonal vegetables. Bolting fertilizer is reapplied to promote lower dormant buds to germinate and form lower branches. It pods on branches, and then rapeseed is harvested to achieve "two times of harvest", which maintains the high yield and oil content of the variety and provides new varieties of rape with a long flowering phase and many flower colors for the development of leisure agriculture and rural tourism. The upsurge of rape flower tourism has been set up in various places, and the multi-purpose utilization of rape can lead the integrated development of rural primary, secondary and tertiary industries and strongly support the implementation of rural revitalization strategy^[1-3]. Application research, achievement transformation and basic research mutually promote and develop. During the period of "2019 Zhejiang Online Technology Market Week in China" held on November 28, 2019, at the "2019 Zhejiang Science and Technology Achievement Auction (Autumn)", the new rape germplasm 'Yingchun No. 1' of Institute of Crop and Nuclear Technology Utilization, Zhejiang Academy of Agricultural Sciences was sold for 1.5 million yuan. The breakthrough of rape blossoming in autumn, winter, and spring instead of blossoming only in spring, and by seeding in various stages, rape can blossom from the National Day to the next May Day. The successful research and development of this achievement has made rape become a crop with a higher economic value^[4-6]. At present, this variety has been planted in Zhejiang, Fujian, Jiangsu, Jiangxi, Anhui, Chongqing, Sichuan, Guizhou, Xinjiang, Beijing and Northeast China. The achievement transformation increases the accumulation of scientific research funds and the funds for the applied research and basic research of the project team. Young scientific and technological talents are introduced to carry out the research and development of new varieties of rape that are precocious and have high yield, high oil content, many colors, and a long flowering period. Major breakthroughs have been made in basic research of high oleic acid content, disease resistance, stress resistance, and low cadmium accumulation. In recent years, a lot of high-level SCI papers have been published on the QTL of rapeseed oil content, localization of limited inflorescence genes, and environmental interactions^[7-9]. Basic research has promoted the breeding of new varieties of rape with many colors, high yield and high oil content, and high-yield and high-oil new varieties such as "Zheyou 50", "Zheyou 51", "Zheyouza No. 1" "Zheyouza No. 2" have been bred, popularized and applied throughout the country. In 2019, the average yield of "Zheyou 51" was 3 628.8 kg/ha, and the maximum yield was 3 756.15 kg/ha, which broke the record of "Zhejiang Agriculture's Best". The annual promotion area of new varieties is more than 133 333.33 ha, of which it is more than 66 666.67 ha in Zhejiang Province, accounting for more than 50% of the sowing area of rape in Zhejiang Province. When rape flowers, hundreds of thousands of tourists from urban and rural areas are attracted to see rape flowers each year, which promotes the de-

velopment of rural tourism and leisure agriculture; the cultivation and maturation of new scientific and technological achievements are strengthened. Since 2016, the rape team has completed the transformation of 6 new scientific and technological achievements, and realized the organic integration of basic research, breeding of new varieties, and achievement transformation. In addition, the project team also attaches great importance to farmer training. From 2016 to 2019, it trained more than 2 000 farmers in Zhejiang Province.

In recent years, Zhejiang Academy of Agricultural Sciences has actively promoted the organic integration of promotion and transformation of scientific and technological achievements with applied research and basic research. At the Trade Fair of "Rural Rejuvenation Forum and Agricultural Science and Technology Achievements in the Yangtze River Delta" hosted by four academy of agricultural sciences of Shanghai City, Jiangsu, Zhejiang and Anhui provinces in the Yangtze River Delta on November 5, 2019, the management right of new broccoli varieties such as "Zheqing 80" and "Zheqing 75", which are bred by the broccoli breeding laboratory of Institute of Vegetables, Zhejiang Academy of Agricultural Sciences was sold for 3.75 million yuan. On December 24, 2019, at the Zhejiang Science and Technology Achievement Auction held jointly by Zhejiang Agricultural Innovation Park Company and Zhejiang Intellectual Property Exchange Center, the starting price of management right of organic cauliflower varieties "Zhenong Songhua 88 Tian" and "Zhenong Songhua 80 Tian" was 3.6 million yuan, and it was finally sold for 5.28 million yuan after 7 rounds of bidding, with a value-added rate of 46.7%. Meanwhile, a sales commission of 1 500 yuan per kilogram of seeds can be obtained from the bidder. This result can achieve significant economic benefits. In addition to carrying out breeding of new varieties in close combination with production reality, the laboratory also applies the latest theoretical research results of microspore culture technology, somatic cell hybridization technology, molecular marker technology, and HPLC-based quality analysis technology to the breeding practice of cauliflower and broccoli, namely using the basic research results to guide the breeding practice, which realizes the positive interaction of basic research, applied research and achievement transformation, and provides stronger support for the promotion of vegetable industry and rural revitalization in the Yangtze River Delta^[10-11]. The laboratory has made remarkable achievements in germplasm innovation, efficient breeding technology and new variety breeding of cauliflower and broccoli, and has published more than 50 papers in SCI journals such as *Euphytica*, *Plant Growth Regulation*, and *Food Chemistry*^[12-14]. The annual promotion area of new varieties in Zhejiang Province is more than 6 666.67 ha per year, partially replacing the imported varieties.

4 Innovation of the cultivation mechanism and model of rural talents

Rural revitalization is inseparable from the cultivation of rural tal-

ents. Scientific research institutions need to promote the transformation of results and provide human resource support for the development of rural history, folk customs, and cultural resources, and comprehensively improve the industrial competitiveness of modern agriculture and the vital force for the prosperity of rural industries. They need to build a number of demonstration bases and cultivate a number of high-end composite leading agricultural talents, front-line high-level application professionals and new professional farmers. In 2018, at the special meeting of the Zhejiang Provincial Government, it is decided that Zhejiang Agronomist College, jointly organized by the Zhejiang Provincial Department of Agriculture and Rural Affairs and the Zhejiang Academy of Agricultural Sciences, was formally established and enrolled in October of the year. The college closely follows the rural revitalization strategy of Zhejiang Province and the urgent needs of modern agricultural development for high-level innovative entrepreneurial talents, and aims to innovate the education and training model of modern professional farmers, do a good job in the province's high-level agricultural professional and technical personnel education and vocational skill training, and train and transport "new farmers" for rural revitalization. In order to better achieve the goal of combining industry-universities-research institutions, the college's teachers are mainly senior experts of Zhejiang Academy of Agricultural Sciences, and experts from relevant colleges, leaders of agricultural technology promotion departments, entrepreneurs, and first-line skilled personnel are introduced to establish a pool of professional tutors and entrepreneur tutors. It recruits the leaders and technical backbones of demonstration farmers' professional cooperatives, demonstration family farms, and agricultural leading enterprises, leaders of agricultural "two-zone" bases, outstanding students of Zhejiang Farmer University, college graduates as "agricultural makers", executives of agriculture-related enterprises, and agricultural production technology backbones as training objects. At present, the college offers two majors of modern agricultural technology and agricultural economic management, mainly cultivating two types of "new farmers" for rural revitalization. One is the skilled and technical "front-line engineers", who are able to guide various local talents in the province to develop rural industries; the other one is "front-line managers" who know technology and are good at operation and management, and they can help millions of farmers develop modern agriculture. These two types of talents are most urgently needed in the rural revitalization of Zhejiang Province. The length of schooling is two years, and credit system teaching is adopted. About 100 students are enrolled each year, who have a high school degree at least and have made certain achievements in the development of modern agricultural industry. The competition for admission is very fierce. Most training funds are mainly provided by the government, and students bear appropriate fees. Among them, tuition fees, teaching material fees, *etc.* are funded by financial funds, while students' round-trip transportation costs, board and lodging expenses, vocational qualification training appraisal fees and other costs are borne by the

students themselves. Professional skills and graduation thesis are jointly finished by the "professional mentor + entrepreneurial mentor", and they jointly implement the integrated training mode of "specialized learning education, production practice training, and technology research and development innovation", and truly achieve the combination of industry-universities-research institutions. The cultivation of these talents will not only effectively promote the further improvement of the industrial prosperity in the rural areas of Zhejiang Province, but also help the transformation, promotion and application of scientific and technological achievements in various fields of the Zhejiang Academy of Agricultural Sciences.

The combination of industry-universities-research institutions is the magic weapon to promote the transformation of agricultural scientific and technological achievements, and it is also necessary to continuously enrich its connotation in the new situation. Zhejiang Academy of Agricultural Sciences promotes the transformation of scientific and technological achievements by focusing on practical technical training, promotes the deep integration of basic research, applied research, and achievement transformation by transferring scientific and technological achievements, and uses the agronomist college as a carrier to promote the integrated development of industry-universities-research institutions and more effectively support the implementation of rural revitalization strategy through systematic personnel training. Finally, initial results have been achieved. Therefore, it is necessary to further explore and enrich the connotation of the combination of industry-universities-research institutions, and make greater contributions to rural revitalization.

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