Rapeseed Studies in Oil Crops Research Institute, Chinese Academy of Agricultural Sciences

Hanzhong Wang

(Oil Crops Research Institute, CAAS, Wuhan, 430062, China)
Email: Wanghz@oilcrops.cn

China is a top producer of rapeseed in the world. Since 1985, the planting area and total production of rapeseed in China have been taking the first place, accounting for approx. 30% of the world. Since 2000, the planting area of rapeseed has kept on more than 7.3 Million ha and the production has totaled about 11million tons. During the last five years in China, 35% of total consumption of the edible vegetable oils and 25% of total meal consumption have been derived from rapeseed.

Oil Crops Research Institute (OCRI), Chinese Academy of Agricultural Sciences (CAAS), was established in 1960 in Wuhan, Hubei Province and was subordinated to the Ministry of Agriculture, P.R. China. It occupies 110 hectares of land and there are 160 research staffs. During the recent years, the Chinese government has set up five national laboratories and research centers in this institute: "National Oilseed Crops Improvement Center", "National Research Center of Rapeseed Technology and Engineering", "Key Laboratory for Oilseed Crops Genetic Improvement, Ministry of Agriculture", " Quality Inspection Center for Oilseeds and their Products, Ministry of Agriculture " and " Environmental Risk Assessment Center for Transgenic Rapeseed, Ministry of Agriculture ".

Rapeseed research is the most important in OCRI. Approximately half the research activities in OCRI are related to rapeseed. The main research areas of rapeseed include:

1）Germplasm resource

This section is engaged in the collection, maintenance, evaluation and innovation of rapeseed germplasm resources, the analysis and protection of genetic diversity, the discovery and utilization of important traits and genes, and the construction of DNA finger maps for rapeseed varieties.

At the present stage, over 7000 different accessions from China and the other nations have been collected and conserved, which include 2200 *Brassica napus*, 2500 *Brassica rapa*, 1900 *Brassica*

juncea and 400 other *Brassica* accessions. The technical system of evaluation, conservation and renovation for germplasm resources has been set. A batch of rapeseed germplasm having important characteristics such as high protein content, high oleic acid content and high phosphorus-efficiency are also identified. The genetic diversity distribution and the evolution of the rapeseed germplasm in China were elucidated with conventional methods combined with DNA marker technology. More than 300 rapeseed cultivars or elite parental lines have been fingerprinted using DNA markers.

2）Rapeseed breeding

In this section, theoretical, methodological and technological studies were carried out on genetic improvement, genetic recombination and gene aggregation. More than 25 rapeseed varieties (hybrids) were bred and released successfully. Their cultivation areas covered to 30% of total rapeseed growing areas in China. The most distinguished of them are Ganyou No.3, Ganyou No.5, Zhongyou 821, Zhongshuang No.4, Zhongshuang No.7, Zhongshuang No.9, and Zhongyouza N0.2.

3） Biotechnology studies

This section is dealt with various fundamental studies such as functional genomics, molecular markers, gene cloning, gene expression and regulation, genetic engineering, biosafety assessment of transgenic rapeseed. Molecular markers for resistance to S*clerotinia* stem rot, apetal, and nuclear male sterility were identified. Genetic transformation system has been established and transformants with herbicide resistance and with resistance to *Sclerotinia* stem rot were achieved. Low erucic acid rapeseed is being developed by transformation procedure with FAE1 RNAi vector. Transgenic studies targeting low glucosinolates were carried out in cooperation with Denmark Royal Veterinary and Agricultural University. A number of new strains of *B.napus* were resynthesized by crossing *B. oleracea* with *B. rapa* and by means of embryo rescue technique. Exploitation of resynthesized *B.napus* in rapeseed breeding is proceeding. A male sterile line, derived from interspecific hybridization between *B.napus* and *B.carinata,* shows good potentiality in application.

4） Physiology and cultivation

This section is mainly focused on high yield physiology, cultivation methodology, efficient utilization of B and P, and precise fertilizing techniques.

Some technologies and theories about rapeseed cultivation were proposed and popularized, such as “High yield cultivation technologies suited to autumn luxuriant rapeseed in the upper and middle reaches of the Yangtze River and correlative biological basis”, “Technologies protecting rapeseed against atrophy and fruitlessness”, “Transplant

technologies on large and strong seedlings", "Large area increased production technologies in double-low rapeseed by strengthening seedling and stem, meanwhile increasing total siliques through higher population density". Additionally, based on the response of rapeseed on different sowing dates (climate factor), simulating growth and development modules of winter rapeseed in the reaches of Yangtze River was established. It was proposed that the physiological indexes and symptoms of rapeseed subjected to B, N and P deficiency. Cultivars that can tolerate low-phosphorus were selected and identified recently.

5） Plant protection

This section is characterized by molecular biology and biological control of harmful and beneficial microbes related to rapeseed.

Epidemiology and assessment of *Sclerotinia* stem rot in rapeseed were studied. Mathematical models were constructed by controllable factors to predict disease occurrence. Long term prediction model for occurrence of *Sclerotinia* stem rot was made on computer on basis of natural factors, outer deduction method of variance analysis and grey topological model.

6）Quality testing and control

This section is responsible for quality analysis, food security detection and quality standard stipulation. An instrument for rapid quantitative determination of erucic acid and glucosinolates in rapeseed was successfully developed by means of photo-electronics, mechanics and computer-assistance, based on the mechanism that glucosinolates in rapeseed change in color with coexistence of specific exotic enzyme and color expression agent, and that erucic acid changes in turbidity with varied content.

7) Processing technology

Oil, protein and other refined products of rapeseed are mainly targeted. The research area in this section ranges from microbial technology, enzyme technology and fine chemistry.

The flow direction and distribution of limiting factors (such as glucosinolates, protein, amino acid fraction, phytic acid, and tannin) to the utilization of rapeseed protein was studies during the process of separation and refining of protein and fatty acids. An efficient system of simultaneous preparation of highly graded protein and fatty acids was established. The seed-coat separator for dry seed-coat separation of rapeseed was successfully developed.

OCRI is also active in the international cooperation. Efficient cooperative research projects have been carried out with institutions from Canada, America, Australia, England, Germany, Japan, Sweden, Denmark, UNDP, IAEA, EU and IPGRI. With the continuous

development of people's life and the oil processing industry, the demand of rapeseed products is beyond supply in China. The annual demand of vegetable oils is estimated to be 19 million tons in the year of 2010 while the total production of vegetable oils in China was only 10.71 million tons in 2001/2002. That means there will be a shortage of about 40% vegetable oil supply in the near future in China. A series of other problems need also to be studied and resolved, such as the double-low quality, low oil content and high production cost. Any further cooperative research will be welcome to explore the huge rapeseed market in China.