Japan-China technical cooperation for rapeseed production in Hubei, China

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Abstract

Hubei Province is a main rapeseed-producing area in China. The rapeseed production project funded by Japan International Cooperation Agency and the Government of People's Republic of China was carried out in Hubei, China from 2000 to 2005. The main objectives of the project were 1) to breed double-low (low contents of both erucic acid and glucosinolate) rapeseed varieties with high performance, 2) to develop appropriate cultivation techniques for high yield and high efficiency, and 3) to expand double-low rapeseed production in Hubei, China. In order to achieve sustainable development of double-low rapeseed production in Hubei, a basic plan for the development of the rapeseed industry in Hubei was drawn up at the end of the project and submitted to the authorities concerned. Although the main objectives of the project were achieved, various problems still remain to be solved for further development of the industry, among which some technical and management issues are discussed.

Key words:*Brassica napus*, double-low, rapeseed, technical cooperation, biodiversity

Introduction

Hubei Province is a major rapeseed-growing area in China, the world's leading rapeseed-producing country (FAO Statistical Yearbook 2004; China Agriculture Yearbook 2005). Rapeseed which is the most important winter crop in Hubei, contributes significantly to the farmers' income. In the 1990s, however, since double-low rapeseed production in China lagged considerably behind, it became essential to improve rapeseed quality and expand double-low rapeseed production in China, particularly in Hubei.

Thus, the rapeseed production project funded by Japan International Cooperation Agency (JICA) and the Government of People's Republic of China (GOC) was carried out in Hubei, China, from 2000 to 2005 (Miyazaki *et al*., 2005). The main objectives of the project were 1) to breed double-low rapeseed varieties with high performance, 2) to develop appropriate cultivation techniques for high yield and high efficiency, and 3) to expand double-low rapeseed production in Hubei, China.

During the 5-year period, a total of US$ 2 million was allocated to the project from JICA and US$ 400 thousand along with land, facilities, *etc*. were provided from GOC. The project was being carried out in close collaboration with the Government of Hubei Province, the Institute of Oil Crop Research and HuaZhong Agricultural University. In total, more than 100 people from both countries were being actively involved in the project, including scientists, engineers, administrators, village leaders, farmers along with Japanese long- and short-term experts.

As a result, the main objectives of the project were achieved. It is also expected that sustainable development of rapeseed production in Hubei could be realized, based on the results of the project.

Highlights of the Project

New double-low rapeseed varieties with high performance, which can meet the demand of farmers, processors as well as consumers, have been released each year. Various farmer-based cultivation techniques such as direct seeding, no tillage transplanting, *etc*. were re-evaluated in demonstration fields, and disseminated to farmers. The percentage of double-low rapeseed cultivation in Hubei reached around 95% (Fig.1). In addition, rapid progress in developing standard methods for erucic acid and glucosinolate analyses and in establishing production systems for high-quality seeds, *etc*. was also made during these five years. Through the activities of the project, technical exchange was actively promoted in various fields of the activities and contributed considerably to the capacity building needed in China.

At the end of the project, a basic plan for the development of the rapeseed industry in Hubei was drawn up and submitted to the authorities concerned, in order to achieve sustainable development of double-low rapeseed production in Hubei. The outline of the proposals contained in the plan is as follows:

1. Enhancing rapeseed production:

1) In order to accelerate rapeseed breeding, concrete benchmarks should be set, with emphasis placed on high yield, high oil and oleic acid contents in addition to the double-low traits. Breeding of *Brassica napus* lines with yellow seed coat should also be encouraged. 2) Through the dissemination of new varieties and new technologies, unit productivity of rapeseed should increase, especially in major rapeseed-producing districts in Hubei. 3) Through the dissemination of labor-saving cultivation

techniques, the production cost of rapeseed should be reduced, with emphasis placed on no tillage cultivation, appropriate mechanization, *etc*. Dual utilization of rapeseed as green vegetable and oil should also be promoted, especially in suburban areas.

2. Enhancing commodity chain:

1) The activities of double-low rapeseed processors should expand and be strengthened, through the adoption of advanced quality standards, technological innovation, technical and financial support, *etc*. 2) Internal service systems related to science, technology and information should be established, with emphasis placed on standardization of cultivation techniques, innovation and application of processing technologies, rapeseed information networking, *etc*. 3) Sound market systems should be developed, for instance futures trading of rapeseed in China, a rapeseed industry fund, whole-sale markets of rapeseed products in major rapeseed-producing districts in Hubei, *etc*. 4) The creation of organizations involved in exchanges between farmers and processors should be promoted, including, for example, Agricultural Cooperatives as in Japan or a Canola Council as in Canada. 5) Rapeseed quality inspection network systems coordinated by the Quality Inspection and Test Center for Oilseeds Products, Ministry of Agriculture, should be developed for periodical monitoring in major rapeseed-producing districts.

3. Special systems for double-low rapeseed production should be established, including 1) the participation of advanced companies with an annual salad oil processing capacity of over 100 thousand tons, 2) open bids for seeds of rapeseed varieties for cultivation use, 3) establishment of production base, 4) contract farming, 5) tightening of sampling inspection of quality, 6) utilization of by-products and establishment of brand name.

4. Development of technology for high purification level of double-low rapeseed oil should be accelerated, in order to produce value-added products.

5. Appropriate legal systems should be implemented for the development of the rapeseed industry, including entry-prevention systems of non double-low rapeseed varieties in farmer's fields along with low quality oil in the market through qualification labeling.

6. Research and development as well as whole rapeseed industry should be promoted, through, for instance, the allocation of local government subsidies to farmers for double-low rapeseed cultivation and necessary support to universities and research institutes for the development of new varieties and new technologies.

Further Considerations

1. Rationalizing farmers' shipments

Although the main objectives of the project were achieved, various problems still remain to be solved for further development of the industry. Among others, fact-finding surveys carried out within the framework of the project pointed out one problem of top priority.

Since rapeseed can only be utilized after being processed into oil or meal, not only farmers but also many other agents are being involved in the rapeseed commodity chain. In Hubei, formerly, there used to be numerous small oil-processing factories throughout the province and farmers could bring their crop directly to the nearest factories by themselves. However, these small factories have gradually disappeared due to the increasing competition with large-scale factories with modern facilities. Thus, middlemen have recently played an important role in long-distance transportation of rapeseed from farmers to processors. Although this stage in the rapeseed commodity chain is extremely important for low-cost production of quality oil with global competitiveness, middleman systems are not well-organized yet and should be improved. The basic plan for the development of the rapeseed industry in Hubei mentioned above recommends the establishment of organizations comparable to the Agricultural Cooperatives in Japan or the Canola Council in Canada.

2. Preventing contamination

In order to provide processors with double-low rapeseed of high quality, attention should be paid to the prevention of rapeseed contamination occurring in farmer's fields as well as in the shipping process. The dissemination of double-low rapeseed varieties may not necessarily result in the production of double-low rapeseed due to contamination (Yanagino *et al*,, 1999; Milford and Evan, 1991).

Within the framework of the project, therefore, a series of field studies was carried out in several major rapeseed-growing areas in Hubei, to identify the factors related to contamination, if any. Seed samples, including commercial seeds for sowing purchased by farmers, mature seeds on the rapeseed plants which were grown with or without net cover during the flowering time and commodity rapeseed shipped by farmers, were collected periodically and analyzed for the contents of erucic acid and glucosinolate at the Institute of Oil Crops Research.

Figure 2 shows the results obtained in 2004. The seed samples harvested directly from the rapeseed plants grown under net cover during the flowering time displayed a good quality, which was slightly degraded under open-field conditions, possibly due to crossing with non-double-low rapeseed grown nearby, and remarkably degraded due to the contamination with harvested seeds derived from conventional varieties and/or weeds lacking the double-low trait. Since then, based on the results, necessary measures have been taken for regulating the handling of conventional varieties, along with the unification of rapeseed varieties at the village or district level. In addition, appropriate crop rotation, especially in upland fields, as well as necessary weed control and appropriate cultivation techniques should be carried out in order to prevent such degradation of rapeseed quality (Pekrun *et al*., 1998; Pessel *et al*., 2001).

3. Transgenic rapeseed

Although the scope of the project did not cover transgenic rapeseed, studies on transgenic rapeseed have been extensively carried out in China (Lu *et al*., 2005). In China, commercial cultivation of transgenic rapeseed is not carried out presently, while large amounts of transgenic rapeseed are being imported from abroad. Recently, feral transgenic rapeseed populations have been detected in Japan, where transgenic rapeseed has not been cultivated commercially (Saji *et al*., 2005). Since China is considered to be the secondary center of diversity for *Brassica* crops, it is necessary to conduct environmental risk assessment for each transgenic rapeseed event carefully before the initiation of commercialization.

By nature, rapeseed displays some characteristics which cannot be easily controlled, including high possibility of cross-pollination, pod shattering, secondary dormancy of seed, among others. Breeders' efforts aimed at genetic improvement of these characteristics are currently in progress. On the other hand, it is very important to specify target species and identify the baseline of their genetic diversity that should be conserved, when environmental risk assessment is conducted.

Conclusion

The Japan-China technical cooperation project was successfully completed in 2005. It will be necessary to follow up the results of the project periodically for further development of the rapeseed industry in Hubei, and also in China. In addition, studies on environmental risk assessment of transgenic rapeseed should be carried out prior to commercial production in China. Close collaboration, in this regard, is being recommended.

Finally, I would like to thank all the people involved in the Japan-China technical cooperation project for their dedication. Without their significant contribution, such achievements would not have been possible.

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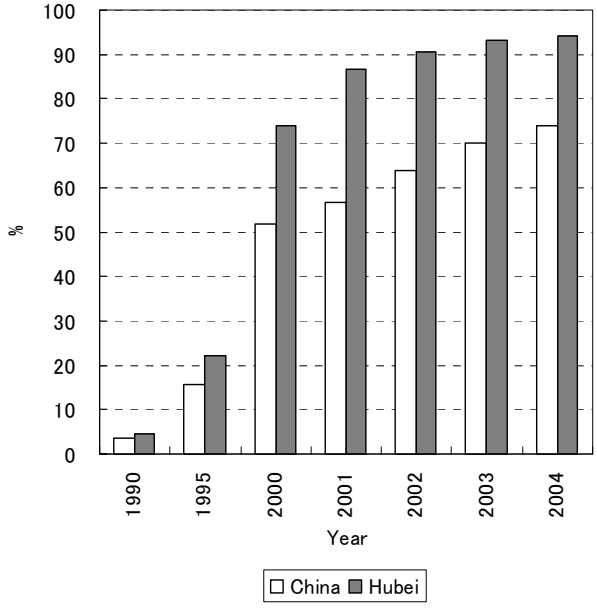

Fig. 1. Ratio of double-low rapeseed cultivation in China and in Hubei Province.

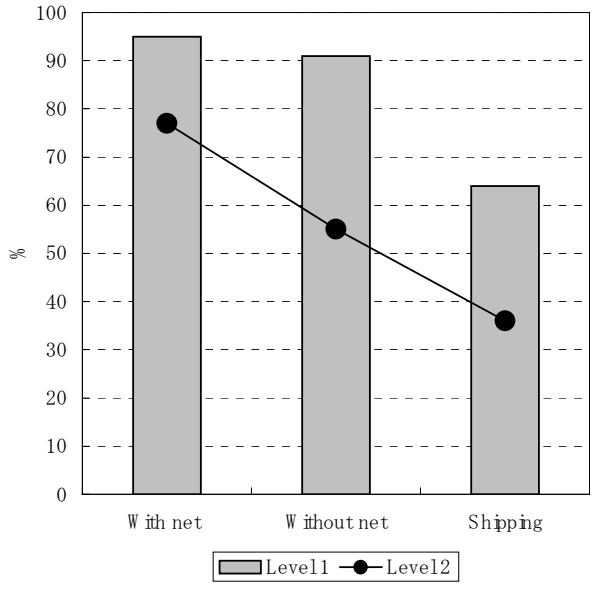

Fig. 2. Results of field studies on double-low rapeseed production ratio in some major rapeseed cultivation areas of Hubei Province (2004).

(Notes)

With net: rapeseed seeds harvested from the rapeseed plants which were grown under isolated conditions by using a net cover during flowering time.

Without net: rapeseed seeds harvested from the rapeseed plants which were open-pollinated.

Shipping: rapeseed seeds at the time of shipping from farms.

Level 1: erucic acid content lower than 5% and glucosinolate content lower than of 45 μmol/g meal.

Level 2: erucic acid content lower than 2% and glucosinolate content lower than 30 μmol/g meal.