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# Chapter 16

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## Crop Breeding and Varietal Release Policies and Distribution System in China

Jiang Liangcai and Liu Zhongqi

### Crop Breeding

The crop breeding programme is the mandate of the Chinese Agricultural Department. Since 1980, the Chinese Science and Technical Committee, which consists of governors and scientists, has been leading the breeding programme. This group has been responsible for the administration of the main crop breeding programme. The Chinese Sci-Tech Committee prepares five-year plans and budgets for economically important crops that have an important impact on food, natural fibre, and oil production in China. Breeders working with the same crop are asked to form a cooperative group. An institute in the Chinese Academy of Agricultural Sciences with proven results is usually appointed as the group leader, and a famous breeder in the Institute is appointed as the director of the cooperative group. Each member of the cooperative group undertakes the task for which they have superior research performance. After five years, the leading group inspects the research progress achieved by each cooperative group and monitors the achievements against a contract signed by the director in the first year of the 'five year plans'. Programme evaluation will eventually determine future funding.

### The Research System for Crop Breeding

The Chinese Academy of Agricultural Sciences (CAAS) and provincial academies and their regional institutes of agricultural sciences look after crop breeding. The national breeding programmes are directed by scientists from the CAAS. Agricultural universities also carry out crop breeding programmes. Some crop research institutes are affiliated to universities, for example the Soybean

Research Institute in Nanjing Agricultural University and the Rice Research Institute in Sichuan Agricultural University.

### *Breeding Objectives*

The breeding objectives vary with the crop. Most crop breeding programmes have the following research process.

- Collection, identification, and conservation of germplasm
- Evaluation of parent material for disease resistance, good quality, and yield
- Development of new lines and combinations
- Variety testing, product demonstration, verification, registration, and extension system

### *The Crop Breeding Method*

The Germplasm Research Institute of the Chinese Academy of Agricultural Sciences is in charge of the collection of various plant germplasms in China. Some groups in provincial agricultural academies also collect local plant germplasms. In order to improve breeding efficiency, plant breeders in China have been employing various breeding methods that use local and exotic germplasm. Some of them are listed below.

- Pure line breeding
- Combination breeding
- Recurrent selection breeding for crop population improvement
- Use of heterosis
- Other breeding methods

### *System to Evaluate Varieties*

There are two systems of evaluating new varieties of crops in China. One is based on cultivation and demonstration of production. Another, the main system, is based on regional tests.

#### **Box 16.1**

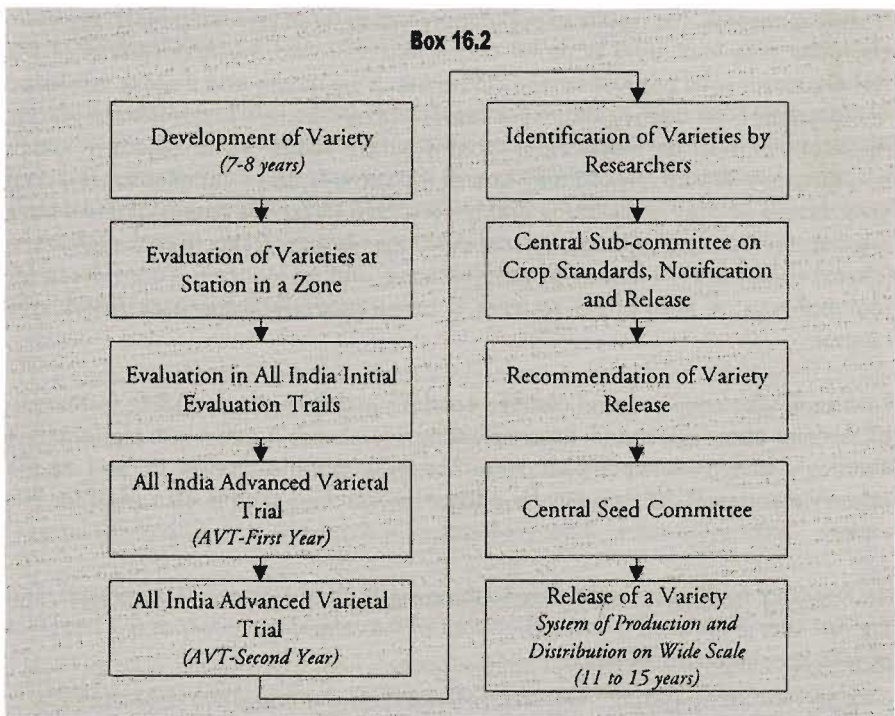
#### ***Variety Testing Procedures in China***

Before being registered, all new lines are tested in yield trials organized by the provincial seed company. After 2-3 years of experiments, new cultivars superior to the reference variety in terms of high yield potential and agronomic traits are sent to the variety verification committee for registration. The new lines are tested and demonstrated in different areas for yield advantage and best domains.

### Testing of Varieties by Demonstrating Production on Large Plots

This system is used for food crops such as wheat, rice, and maize (Box 16.2). The system has advantages as the extension of new varieties is rapid. However, it exposes farmers to the risk of crop failure in specific areas. There have been examples in which the varietal stability and suitability of some varieties were poor. Good performing varieties are registered by the variety verification and registration committee and then distributed quickly. For example: Yu Kang 2 (a variety of tomato) was grown on 1,800 ha in 1989-1991 and registered in 1992; Gong Ji Zhe (a variety of bean) was registered in 1992 after cultivation on demonstration plots in 1989; and Shan You No. 64 and D You No. 49 (varieties of rice) were released after they were grown on large plots in 1992.

**Box 16.2**



### Testing of Varieties at the Regional Level

The testing of varieties at the regional level means that newly bred or introduced varieties are grown in representative districts to test their distinctness, uniformity and stability. In regional tests, varieties are screened for disease resistance and yield potentials. Preliminary yield trials are conducted at the originating institute

(university) for two to three years. Successful varieties in these preliminary trials are tested in national (or provincial) uniform yield trials for a further two to three years. The purpose of regional trials is to assess the degree of adaptation to make full use of potential varieties and find varietal niches in different ecological districts. The demerit of the system is the time taken before products reach farmers.

Regional tests of varieties are divided into national and provincial tests. The Seed Administration Department and the Academy of Agricultural Sciences manage multi-locational regional variety tests. Sites and institutes are selected. An application for variety nomination must be made before the variety is considered to facilitate initial screening.

The application must contain such details as the source of the variety, the breeding process, the results of preliminary two to three year yield trials, the main characteristics (including parental characteristics), and the main points of the techniques for seed production and cultivation. If the quality and disease resistance of the variety have been tested, these results will also be sent to the administrators. Applications must be made three months before seeds are to be sown. Each breeding unit should choose only one of the same types of varieties for regional tests, based on the results of the preliminary yield trials. The results of these trials are discussed annually at regional trial meetings, varieties better than the reference (check) variety in such factors as yield, disease, and resistance are considered for regional tests. A total of 10 varieties is tested in every group trial including a control.

Foundation seed or good certified seed is supplied by the breeding institute to all test sites about one month before planting time. Seeds are sent with a quarantine certificate and a variety introduction. The most popular variety is used as the reference variety. Good quality foundation or certified seed is also used for this variety.

Regional trials usually take two to three years. Varieties are eliminated during the first year if the yield is lower than that of the reference variety and it does not possess special characteristics.

### **Production and Cultivation Experiments**

The purpose of production experiments is to determine the yield potential of elite varieties. Usually production experiments can be carried out during regional tests. If a variety is good in the first or second year of the regional test, it may be lined up for production experiments the following year. The method of experiment is to compare yields over a large acreage. The area for small grains such as rice and wheat is usually more than 0.067 ha, and that for big grain crops, such as

cotton, maize, and sweet potato, more than 0.134 ha. Trials are not replicated. The quality of the land used for the experiment and the reference variety are the same as those in the regional test. The cultivation method is chosen on the basis of the characteristics of the variety to be tested and the reference variety. Varieties are inspected and growth compared before harvesting. The production experiments are also used for demonstration and seed multiplication.

Agronomic experiments are carried out at the same time as production experiments, or when extension of a variety is permitted. Agronomic experiments are carried out to investigate the effects of such factors as climate, soil, density, fertilizer, water, and sowing date which depend upon location specificity. The purpose of such experiments is to recommend the best husbandry methods for new varieties on a large acreage.

### **Summary Report**

All cooperating institutions need to submit summary reports of agronomic and regional tests. After completion of testing, varieties are assessed. The administrators will recommend the best varieties to the verification and registration committee, which will verify and register it according to the rules. Agricultural administrators are then free to distribute the new cultivars.

### **Verification and Registration**

Crop variety verification and registration committees exist within each province or autonomous region of China. The committees include representatives from the following: the official for agriculture, the agricultural research institute, the agricultural university, the food department, and the industry committee. The committee members vary according to the needs for the crop. The seed administration unit is responsible for the daily work of the committee.

### **Functions of the Variety Verification and Registration Committee**

The crop variety verification and registration committee is a special organization established to verify and register new crop varieties. Its main tasks are as follow:

- to register and approve of new varieties;
- to evaluate and recommend the agronomic practices and recommended domains for the registered variety;
- to suggest and revise extension messages related to the new varieties;
- to nominate varieties for regional tests; and
- to name and popularise the new varieties.

The following conditions must be met for variety release and registration purposes.

Stable characteristics, a complete set of material from experiments conducted for two to three years, a preliminary yield trial, a regional test, and one to two years of production experiments.

A new cultivar should have a yield at least 10 per cent higher than that of existing reference varieties to be considered superior. If its yield is equal to that of older varieties, then the new variety should be distinctly superior to existing varieties in at least one or more other characteristics (for example quality, maturity, adaptability, resistance) and at least satisfactory in all other important respects, or have a special economic value for some other reason.

Foundation seed should be sufficient for planting on 3.3-6.7 ha. The breeding unit should produce breeder seed.

### **The Procedure for Verifying and Registering a New Crop Variety**

Breeders submit an application containing the following:

- an application form with an illustration of the variety;
- a complete set of materials related to the regional tests and production experiments;
- materials related to the quality and resistance of the variety;
- a picture of the plant, ear, seed, and fruit (or root tuber, tuber);
- a description of parental characteristics and the technique of propagating and producing seed of the hybrid; and
- a suggested name for the variety.

The chair of the committee is responsible for examining the results of the regional test and production experiments and the recommendations of the specialist groups, and verifying and registering the variety.

### **The Extension System for New Varieties**

Usually, in China, the varieties planted by farmers are good. The role of the government is to formulate seed policy. The agricultural departments of the country, province, or county governments are responsible for managing seeds.

### **Seed Production**

Seed production includes production of basic seed, registered seed, and certified seed. There are two channels for producing seed in China. One is the

national production base (for example, state owned farms, collectives, or people especially appointed for seed production). This channel is specialised. The other channel is for a village to set up a seed production base to produce seed for themselves. Units for producing commercial seed must obtain a 'seed production permit' from the agricultural administration. The condition for obtaining a 'seed production permit' is that the technological ability and equipment of the unit or person to produce commercial seed must be well-suited to the task of seed production. The unit or person must abide by the technological rules of commercial seed production.

Seed plots are planted on a large acreage to meet market demand. It is common practice for farmers to buy certified seed of new varieties of crops as a seed supply as improved varieties become available. Farmers may harvest seed from their own crop for successive plantings. In practice, many of them buy seed every year or every other year if they cannot maintain the purity of the variety.

### **Seed Pricing and Costing**

The importance of price varies from one market to another and between different segments in the same market. For example, non-hybrid seed, which the farmer can save, will be more price sensitive than hybrid seed. Price will be a more critical factor in marginal farming areas in which spending power is low, but less important where high yields can be obtained and farm produce can be sold profitably.

Costs include the cost of the processed and packaged seed and the marketing costs associated with selling and distribution. Costs may be grouped according to the activities involved, notably:

- seed production, involving procurement, processing and storage, quality control, and certification;
- seed marketing, taking into account marketing, market research, advertising and promotion, sales and distribution; and
- administration and finance.

### **Seed Trade**

Usually about 35 varieties are verified and registered in Sichuan, China, annually. Hybrid seeds of the main crops are traded by units appointed by county, provincial, and national governments. Seed is traded through many channels under the guidance of the public sector seed administration. The seed companies of agricultural departments at all levels are a main channel for producing and trading seed. These companies are responsible for planning seed production and

providing good varieties. Research and teaching units may sell hybrid seed from their own breeding products. Seed companies belonging to the county agricultural administration may set up seed stations to sell seed to farmers in village areas. Their 'seed trade permit' is handled by a seed company. Seed must be quarantined before it is sold. The marketing channels for seed in China are as follow:

- state-owned corporations;
- state-owned research units and universities;
- private enterprise; and
- agricultural experimental stations.