New Method to Identify and Improve Purity of Two-Line Hybrid Rice With Herbicide Resistance Gene

Scientists from China National Rice Research Institute were the first to introduce a new, world-class technique to identify and improve the purity of the two-line hybrid rice variety. At present, the two-line hybrid rice variety is of great economic importance to China. It has the highest yield compared to the three-line hybrid variety and the normal rice variety. There is evidence of a strong relationship between hybrid rice productivity and seed purity. The two-line hybrid rice is produced by hybridization between a photo-thermo sensitive genetic male sterile (GMS) rice line (Peiai 64S) and a paternal rice variety. However, the fertility of the GMS line is unstable, as it varies with the prevailing climatic conditions. This will lead to self-fertilization of the GMS line, resulting in the contamination of the desired hybrid seeds with the non-hybrid ones. A major problem, therefore, in the development of the two-line hybrid rice, is in trying to separate both types of seeds.

To achieve this end, a herbicide resistance gene was introduced by particle bombardment into the paternal rice variety used for hybrid rice production. Herbicide-resistant transgenic plants were produced from immature embryos bombarded with DNA-gold powder. Polymerase Chain Reaction (PCR) and Southern Blot analyses were conducted to confirm the integration of the herbicide resistance gene into the plants. Homozygous transgenic seedlings were then selected from the T2 transgenic generation. After several rounds of rigorous selection of the progenies based on the criteria used for breeding, only varieties with good agronomic characteristics and stable herbicide resistance were selected to be the paternal rice variety.

The paternal variety was then crossed with Peai 64S. Seedlings from the cross were sprayed with herbicide at the 1–2 week stage. After three to four days, only the hybrid seedlings which have transmitted and expressed the herbicide resistance gene from the paternal line survived; non-hybrid seedlings resulting from self-fertilization of the herbicide-sensitive GMS line would have been killed off. Therefore, the purity of the hybrid line can be tested as early as four days after spraying the herbicide, thus making identification at least 30 times more efficient than with the previous method. The maximum production potential of the two-line hybrid can then be realized since all seedlings produced are true hybrids. As such, this method is expected to help promote the two-line hybrid rice variety.

Japan Develops High Yield Paddy Plant

Scientists from the Japanese Institute of Agricultural Resources and Nagoya University have found that the photosynthesis genes of maize and paddy are similar. They have successfully transferred the maize gene, responsible for the synthesis of phosphoenoyl pyruvate carboxylase, into the paddy plant. This has increased the carbon dioxide fixation rate in the paddy plant by 5%-10%, and the photosynthesis capacity by 40-100 times — comparable to that of maize. The research team is of the opinion that C4 plants contain two other enzymes which are important in photosynthesis, and research into these enzymes could further enhance paddy yield.

Plants can be divided into two categories: C3 plants such as rice and wheat, where carbon dioxide combines with oxygen to form a three carbon compound, and C4 plants, such as corn and sugar, in which carbon dioxide combines with oxygen to from a four carbon compound. The yield in C4 plants is therefore higher than in C3 plants. One way to increase yield in plants is to increase the rate of photosynthesis.
China Conducts Biological Experiments in Outer Space

On 20 October 1996, the Outer Space and Application Department of the Chinese Academy of Sciences conducted a series of experiments to test the culture and breeding abilities of animals and plants in outer space. A number of animals, plants, marine life, microorganisms, and living tissues were used as test subjects. Thirty-three test samples were placed in an experimental container and launched into space via an experimental satellite. The samples were analyzed and treated for three months after the satellite was retrieved.

The results of the experiment revealed that the living tissues were able to continue normal growth and development in space. Higher plants germinated, and their plantlets grew in space; the first cultures of brain cells were successfully obtained; insect pupation and development were recorded; and some strains of algae with high salt tolerance and edible fungi strains were obtained.

Since 1987, the China Research Institute of Space Technology has been sending out crop seeds such as barley, wheat, rice, cotton and soybean into outer space by means of satellites and high-altitude weather balloons. Seeds from a total of nine retrievable satellites have been studied, and recently China’s 17th retrievable satellite has been delivered to the Ministry of Agriculture, the Chinese Academy of Sciences, and to some localities.

It was found that conditions such as microgravity and space radiation can give rise to mutants and new improved varieties of crops which are high-yielding, disease and insect resistant. For example, a new variety of pepper developed in outer space had a 100% increase in yield (5000 kg per mu) over normal varieties. So far, several hundred new quality and early crop varieties have been bred and selected this way. They have since been introduced throughout China for agricultural production.

Hong Kong Professor Develops New Diagnostic Drugs

The pioneering work done by Professor Wu Wenhan ( 吳 文 翰) of the Hong Kong University’s Department of Microbiology, in the field of diagnostic drugs, has received justifiable recognition. These drugs are of use in detecting Rhinopharyngocele (a form of cancer, quite common in Hong Kong and South China), and of salmonellosis, which causes food poisoning.

Although there is stiff competition from western companies, which have monopolized the production of diagnostic drugs, as well as from Singapore and Taiwan, Prof Wu is hopeful that his drugs for diagnosing Rhinopharyngocele will secure at least 30% of the market in five years.

Funded by his own department and tried out on patients from the neighboring Hospital of Mary, Prof Wu led a team of researchers which worked on the planning and development of the project. Initial production was possible with the help of the Government’s Industrial Support Fund, but commercial production now requires large capital from participating companies, as well as increasing available facilities to meet GMP requirements.

Prof Wu’s research team has also been successful in producing two new methods to examine Salmonellosis. As opposed to the four days required to examine salmonellosis by the traditional method, Prof Wu’s discovery can give a reliable detection from a batch sample in 24 hours, while also reducing human error and allowing the timely control of this infection.

Prof Wu, who is planning to expand his research team, feels that China should supply basic research, while Hong Kong can contribute towards product development and marketing.
Chinese Rice Genome Project

After three years of hard work, the Gene Research Center of the Chinese Academy of Sciences has succeeded in constructing a complete physical map of the rice genome. This project was headed by Professor Hong Guopan. Such projects are also being carried out in Japan, the US, South Korea, and the Philippines. Japan first constructed the genetic map of the rice gene in 1994. The rice genome project consists of three parts: genetic map, physical map and sequencing the DNA. The rice gene consists of 430 million nucleotide pairs.

The physical map unravels the enigma of the genetic information and provides information which is important for breeding. The physical map, constructed by China, is characterized by the high resolution of 120 000 basepairs and by the harboring of 565 genetic markers, of which 100 are commonly used. These facilitate the isolation of the desired rice genes, as well as that of rice-like cereal crops.

Under the ninth Five-Year Plan, China will further conduct studies on sequencing the rice genome. The SCST, CAS and the Shanghai City Government will continue to support such studies.

Plants from Chrysanthemaceae Offer Possible Cure for Cancer

Medical scientists from Japan Medical University have discovered the existence of substances effective against cancer from their analyses of 14 plants from the family Chrysanthemaceae, including the chrysanthemum, sunflower, dandelion and grand Persian chrysanthemum. They went on to isolate 21 types of triterpene from these cancer-resisting substances.

Experiments were conducted to test the effects of these substances on skin cancer. 50 µg of DBBA, an oncogenic substance, was applied to the backs of two groups of white mice. After one week, the cancer-suppressing substances extracted from the plants were applied to the mice — 2 mg of sterol dandelion was applied to one group of mice, followed by 1 mg of TPA, a chemical compound known to include skin cancer, after 30 minutes. An equivalent amount of Furagioru (name of a cancer-suppressing product) and later TPA was applied to the second group of mice. The results indicated that all the mice in the control group, which did not receive the cancer-suppressing substances, developed skin cancer, while only 20% of the mice treated with sterol dandelion developed cancer. The most effective cancer-suppressing substance appeared to be Furagioru, since mice treated with this product were cancer-free.

(Source: Xinhua News Agency, Tokyo)
China’s National Rice Engineering Project Shows Signs of Success

The ‘National Rice Engineering’ project, which has been listed as one of the key research projects under the ninth Five-Year Plan is progressing well after one year of implementation. The project was initiated by the Chinese State Science and Technology Commission and is carried out by the Hunan Provincial Government. Last year, an average yield of 1168 kg/mu was obtained from 11,370 mu of very high yield demonstration plots at villages located in Liling City (醴陵市), Xiangxiang City (湘鄉市) and Lingyi County (臨湘縣). This is 14.4% higher than the mean yield of the last three years. The average yield per mu from five very high yield demonstration town plots (totaling 97,400 mu) was 1053 kg which is 10.9% higher than the mean yield of the last three years. The average yield per mu from three very high yield demonstration counties/cities plots (totaling 1,323,200 mu) was 979 kg, which is 7.3% higher than the mean yield of the last three years.

In order to achieve the strategic goal of increasing rice yield by two billion kg in Hunan Province (湖南省) and 14 billion kg in the whole of China, the State Science and Technology Commission (SSTC) signed an agreement in December 1995 with the Hunan provincial government. This agreement covers the ‘National Rice Engineering’ project. Since then, research, large scale development, and demonstration have been carried out with guidance from the SSTC and the Hunan provincial government. Particular attention was given to the technical difficulties faced at the provincial or national level. So far, 199 sets of experiments have been completed.

Three techniques used in the ‘National Rice Engineering’ project were tested under the following conditions:

- high yield highland zone
- medium yield highland zone
- medium yield zone around Dongting lake

The target was to reach 100 mu of very high yield plots, 100,000 mu of high yield experimental plots, and 1,000,000 mu of high yield demonstration areas. The harvest turned out to be good, and the local cultivation techniques were very much improved. Statistics showed that when fields were cultivated to the maximum, and different crops were planted within the same cultivation area, crop production increased significantly. The new techniques were well-received by farmers.

Research and development has helped to increase rice production by 59.3% in the 10,000 mu of very high yield fields, and 55.7% in the 100,000 mu of the high yield demonstration zone. Experts have predicted that for larger demonstration areas, spring cultivation will increase to 500 kg/mu. After more than one year of hard work, researchers have come up with more new techniques. Some of these techniques involve saving fertilizer, are less labor intensive and require less seeds, yet maintain high yields. It is estimated that early spring cultivation will cover 100,000 mu of experimental fields, one million mu of demonstration fields, and ten million mu of high yielding fields, where the yield will reach 500 kg and above/mu. Among these, 10,000 mu of the main experimental fields are expected to produce 530 kg/mu while the 100 mu of the ‘21st century high yield demonstration fields’ attended to by experts, is expected to reach a yield of 550-600 kg/mu.

(Note: 1 mu = 0.067 hectare)