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THE DEVELOPMENT OF COTTON BREEDING PROGRAMMES IN THE PEOPLE'S REPUBLIC OF CHINA

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ABSTRACT

In the last fifty years, China has moved from relying entirely on introduced cotton varieties to growing locally bred and selected varieties. The breeding programmes has developed from introduction through systematic selection to hybridisation and, most recently, radiation breeding. The history and achievements of cotton breeding in China are outlined in this paper.

KEYWORDS

Gossypium arboreum, G. heraceum, G. hirsutum, introduction, selection, hybridisation, radiation breeding.

INTRODUCTION

Great advances in cotton varietal improvement has been made during the last century in China. The obsolete varieties of *Gossypium arboreum* and *G. herbaceum* have been replaced by commercial varieties of *G. hirsutum*. As a result of cotton breeding, locally bred varieties have replaced introduced varieties. Preliminary and simple breeding programmes have been replaced by advanced and more complex ones (Table 1 and Figure 1).

I would like to describe these transitions in more detail.

INTRODUCTION PROGRAMMES

Introduction programmes played an important role in the past but their importance has rapidly decreased. Because China does not have endemic cotton species, cotton cultivation initially depended on commercial varieties being introduced from abroad, from the U.S.A. especially. Since the founding of the People's Republic of China in 1949, cotton cultivation systems have undergone tremendous changes and varieties from abroad do not meet the needs of our new system. Varieties bred by institutions in China proved to be more suitable and more welcomed by peasants. Domestic cotton varieties gradually replaced exotic varieties. For example, prior to 1949 about 63% of the varieties cultivated were introduced, such as Trice, King, Acala, Stoneville, Delfose, and Deltapine; only 41% of the varieties under cultivation were introduced in the 1950s; the percentage continually reduced to only 3% in the 1970s. Today, no exotic variety could be prominent. Exotic varieties, however, played an important role in the past, especially the variety Deltapine 15, which was grown on about 2 million hectares at its most popular stage, and from which a lot of new varieties have been derived, for example 洞庭一号 (Dong ting 1), 南通五号(Nan tong 5). 细棉一号 (Se mian 1). All of these were valuable commercial varieties in different cotton growing provinces at one time.

Table 1. The relative area in cotton varieties bred by different programmes from the 1940s until the present day.

Year	Prior to 1949				1950s				1960s				1970s				1980-1984				TOTAL			
Breeding Programme*	I	S.B	H.B	R.B	I	S.B	H.B	R.B	I	S.B	H.B	R.B	I	S.B	H.B	R.B	I	S.B	H.B	R.B	I	S.B	H.B	R.B
No. of varieties bred	9	3	1	0	11	12	4	0	2	27	16	0	2	39	23	1	0	3	24	2	24	84	68	3
Percentage of cotton area	69	23	8	0	41	44	15	0	4	60	36	0	3	60	35	2	0	10	83	7	13	47	38	2

*I = Introduction
S.B = Systematic selection breeding
H.B= Hybridization breeding
R.B = Radiation breeding

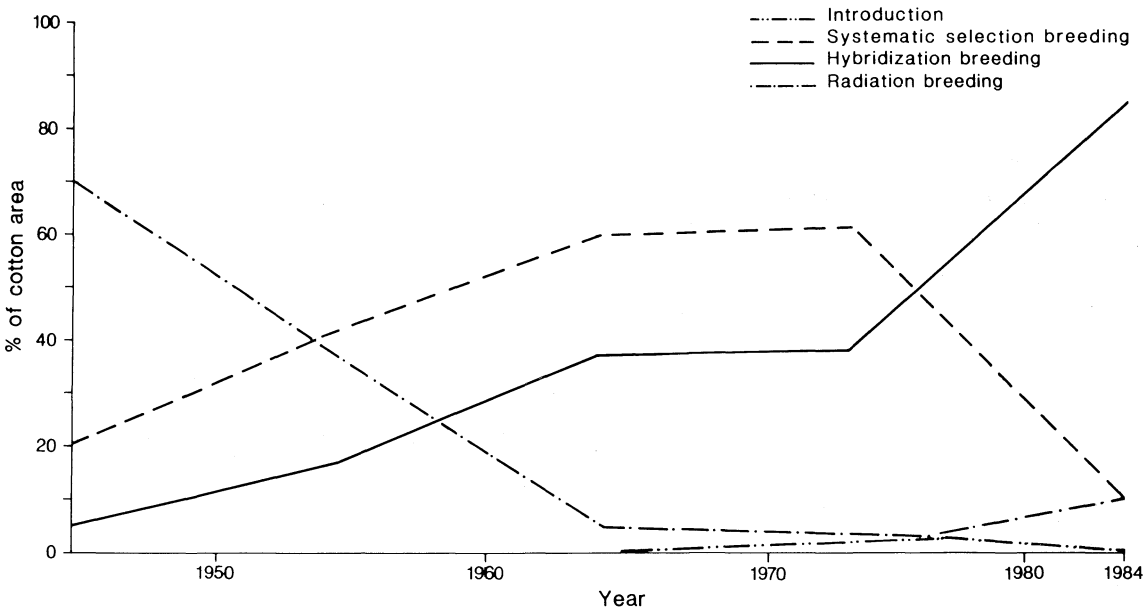

Figure 1. Comparison of the rates of varietal development from different breeding programmes.

SYSTEMATIC SELECTION BREEDING PROGRAMMES

Systematic selection breeding played an important role in the early breeding programmes.

Systematic selection made cotton varietal improvement possible because of the genetic heterozygosity often present in cotton, a crop plant characterised by cross pollination. Secondary selection often proved to be effective due to the residual variation in certain varieties.

During the years when the introduction programme was at its peak, the systematic selection breeding programme did not demonstrate its advantages. But the exotic varieties displayed genetic variation under new growing conditions and cultivation systems so a basis for the development of systematic selection breeding programmes was available. The innovation of technology in selection, scoring, evaluation, etc., also made possible the further improvement of cotton varieties through systematic selection breeding programmes. Systematic selection breeding replaced introduction as the major source of varieties.

China is a big country with a population of about 1 billion. Initial efforts in cotton breeding were aimed at providing clothing and at other domestic uses for all the people. Breeding cotton with high yielding capabilities was the chief breeding target. Domestic varieties such as 徐州 1818 (Xu zhou 1818), 泗 棉 1 号 (Dong ting 1), 中棉所 3 号 (Zhong mian suo 3) were all well known for their high yields and were all bred through systematic selection breeding programmes. The success of the systematic selection breeding programme resulted in the expansion of domestically selected varieties to 60 percent of the total cotton growing area in 1979, compared with only 44 percent in 1958. Cotton yield per unit area increased simultaneously. The nation wide average lint yield per hectare was 224.2 kg in the 1950s, 338.5 kg in the 1960s, and 453.8 kg in the 1970s.

It's a natural tendency for systematic selection breeding programmes to replace the introduction of varieties, but to enrich the germplasm materials to be used in breeding, introductions should still be adopted at times.

Although high yielding varieties bred by systematic selection breeding programmes made great contributions to the total output of cotton in China, which has ranked first in the world since 1984, the fibre qualities of these varieties urgently needed improvement. Large amounts of raw cotton were left in stock due to its inferior qualities.

Systematic selection breeding programmes are really a process of screening a segregating population of a certain variety, and it is generally difficult to integrate desirable genes or traits present in different varieties. The next step in cotton breeding in China was therefore the development of hybridisation programmes. Even so, systematic selection is still a useful technique, particularly for screening simply inherited desirable characters.

HYBRIDISATION BREEDING PROGRAMMES

Hybridisation was the next major approach to cotton breeding.

Since the late 1970s, the development of agricultural and industrial production and the improvement of people's standards of living have led to an urgent demand for cotton varieties not only with high yields but also with excellent fibre qualities (especially fibre strength). Such a goal was reached through hybridisation programmes. Germplasm material accumulated in the last several decades laid a good basis for hybridisation programmes. Before 1949, varieties bred by hybridisation programmes were only 8% of the total under cultivation. Their importance increased gradually to 15% in the 1950s, 36% in the 1960s and 1970s, and 83% in the early 1980s. This steady increase indicated the effectiveness of this breeding programme. Promising varieties bred by this programme such as 陕棉 1155 (Shan mian 1155), 河南 79 (He nan 79) 豫棉1号 (Yu mian 1), 鄂沙 28 (E sha 28) were each grown up to an area of about 66 000 hectares.

The widespread distribution of varieties developed by hybridisation programmes resulted in a rapid increase in the area growing domestic varieties. In 1984 the area growing Chinese-bred varieties amounted to 83 percent as compared with 15 percent in 1958. Additionally, the national average lint yield reached 678 kg/hectare compared with 378 kg/hectare in 1958.

There is now a tendency towards more complex hybridisation programmes. Hybridisation breeding was originally confined to single crosses involving only two parental lines, followed by successive selections. This did not give maximum opportunity to recombine desirable genes or traits. Any negative association between economic traits couldn't be broken readily, and cotton varieties with desirable comprehensive characteristics were still very rare. Dr T.W. Culp of the United States researched intermating among different hybrid strains and changed the original correlation coefficient between lint yield and yarn strength from -0.94 to 0.45. This work resulted in the Pee Dee strains with reasonable lint yields and excellent fibre qualities. Modified backcrosses and other more complicated hybridisation research among different varieties also resulted in the correlation coefficients between yield and earliness, and yield and verticillium wilt resistance shifting from negative to positive. These preliminary achievements are encouraging.

SUMMARY

To summarise, an optimum cotton breeding programme has been developed as a result of the improvement of a cotton cultivation systems; the national demands for cotton production; and the improvement of breeding material and technology.

The People's Republic of China is now striving to develop industry as well as agriculture production. Cotton breeding, like that of other field crops such as rice, wheat and barley, has undergone many changes. Now, because of our open door policy and our trend towards self reliance, and with the assistance and collaboration of other countries, we are trying to use the most favourable cotton breeding programmes to produce improved cotton for our people and for the people of the whole world.