Establishment of a Virus-Free Citrus Propagation System in Hunan Province, China

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ABSTRACT. Hunan Province is a major citrus-producing province in China with a total planted area of 213,000 ha. Several graft-transmitted diseases occur here, namely huanglongbing (greening), exocortis, tristeza and tatter leaf. The Hunan Virus-Free Propagation System was established in the early 1980s jointly by the China Department of Agriculture and the Hunan Department of Agriculture. Fifty-six cultivars selected from different areas of Hunan and some imported varieties have undergone thermotherapy, shoot-tip grafting and indexing. From these, 30 pathogen-free cultivars are maintained in a primary source mother block which has produced 170,000 containerized plants for secondary source blocks and 1.5 million plants for commercial plantings.

Hunan Province is one of the major citrus-producing provinces in China with a total planted area of 213,000 ha in 1994. Important commercial cultivars include satsuma mandarin, Ponkan mandarin, navel and other sweet oranges, kumquat and pummelo. Since the early 1980s, new orchards have been established with high quality varieties of navel orange, Bingtang orange, Valencia, Ponkan mandarin and fragrant pummelo. Unfortunately, graft-transmissible diseases were spread because of the lack of a control system. For example, Bingtang orange mother trees were infected with both exocortis and tatter leaf (6). The Hunan Virus-free Propagation System was, therefore, established jointly by the China Department of Agriculture (CDA) and the Hunan Department of Agriculture (HDA).

DISEASES IN HUNAN

Many new varieties were introduced into Hunan in the 1970s, and it is believed this resulted in the spread of diseases. The following are known to occur:

Exocortis. Trifoliate orange rootstock is widely used in Hunan. Field surveys together with biological indexing using Etrog citron and sequential polyacrylamide gel electrophoresis have shown that Miyagawa Wase and Owari satsumas are infected with citrus exocortis viroid (CEVd) (5).

Tatter leaf. Between 1987 and 1992 trees in different commercial orchards were indexed for citrus tatter leaf virus (CTLV) using Rusk citrange. The following varieties were found to be infected: Bingtang, Mang tangerine, blood orange, fragrant pummelo and Ponkan mandarin. Since trifoliate rootstock is common, typical symptoms of CTLV infection were present, namely leaf yellowing and leaf dropping, budunion crease and the associated easy stem breaking (8).

Huanglongbing (HLB). HLB was found in the southern province in 1982 (3). Following this, a survey was conducted noting field symptoms with confirmation by graft inoculation to Ponkan indicator seedlings and electron microscopy (EM). The HLB liberobacter was detected in a few orchards in Chen, Yizhang and Rucheng Counties. The infected trees were destroyed, and no new cases have been reported in the last nine years.

Tristeza. By indexing using Mexican lime indicator plants, citrus tristeza virus (CTV) was shown to be

widespread, but it has not been a major problem due to the use of CTV-tolerant rootstocks.

Satsuma wilt. This new disease, not yet shown to be graft transmissible, is a serious problem in a few orchards causing leaf curling, yellowing and leaf dropping (7).

HUNAN VIRUS-FREE PROPAGATION SYSTEM

The first virus-free mother tree orchard was established in Qiangyang County in 1982, but was abandoned in 1984 because of citrus canker infection (8). In 1986 the CDA and the HDA selected the Zhaxi reservoir area in Anhua county as a site for a disease-free propagation farm. It is under the direction of the Hunan Cash Crop Bureau (HCCB) in cooperation with the Plant Protection Department of the Hunan Agriculture University (HAU), the Hunan Plant Protection and Industrial Station (HPPIS) and the Agricultural Bureau of Anhua County. The system operation is shown in Fig. 1. The steps in the system are as follows:

1. Selection of varieties. A list of required citrus varieties was prepared by the HCCB, and the HAU and people of the propagation farm collected the budwood. So far, 56 true-to-type selections have been made, namely 14 sweet orange, nine navel orange, 15 satsuma, three Ponkan, three summer orange, four tangerine and eight other types.
2. Elimination of pathogens. This has been conducted by the HAU, and was designed to eliminate the four major pathogens recorded in Hunan. A combination of thermotherapy as described by Calavan et al. (1) followed by the shoot tip grafting method of Navarro et al. (4), and including de Lange's (2) method of grafting the emerging shoots onto established seedlings was employed. The grafted plants were then indexed following the directions of Roistacher (5):
   a. HLB using Ponkan seedlings and EM
   b. CEVd using Etrog citron Arizona 861-S1 and electrophoresis,
   c. CTV using Mexican lime, and
   d. CTLV using Rusk citrange.

   Thirty disease-free selections have been obtained and are now maintained in the primary mother tree foundation and germplasm repository. The selections are eight satsumas, eight navels, six other sweet orange, four tangerines, two Ponkans and two Bingtang oranges.
3. Establishment of primary mother block. The provincial mother block is a 7-ha site in the Zhaxi reservoir area in Anhua County. It is surrounded by water on three sides, and the area has warm temperatures, fertile soils and is well watered. All trees are inspected for trueness to type and for absence of disease symptoms before registration for propagation purposes. One tree from each selection is kept in a germplasm repository screenhouse under strict sterilization and quarantine regulations. The trees in the foundation block are evaluated for their horticultural qualities annually, and are re-indexed for graft-transmissible diseases every 2 to 3 years. The provincial mother block is the source of budwood, rootstock seed and seedlings for the secondary mother blocks.
4. Establishment of secondary mother blocks. The first secondary mother block is a 2-ha site at the Anhua Citrus Propagation Farm. In total there will be 10 such blocks and nurseries in different parts of Hunan, six of which were established by the

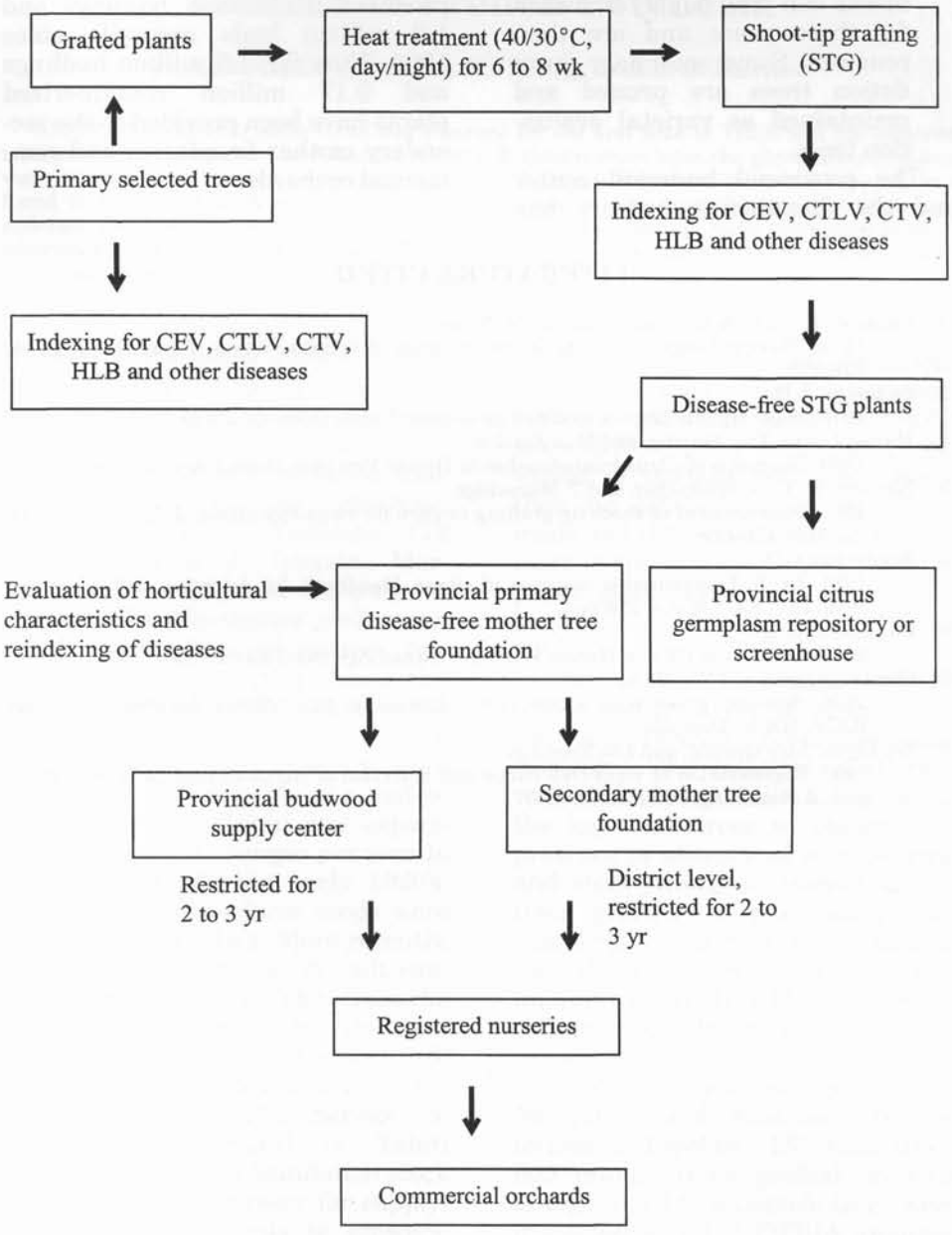

Fig. 1. Flowchart of the Hunan disease-free citrus propagation system.

end of 1994. These are located at Changning in southern Hunan, Longhui in the center and Jingzhou in the west. Each secondary block has a total area of 3.5 ha, 2 ha of which is for the nursery and the remaining 1.5 ha as the budwood block. Each is designed to produce 0.5 million budlings annually. The same record keeping and quarantine regulations used for the primary blocks are used in these blocks. Prior to the release of budlings, they are inspected for disease symptoms in order to be certified. The provincial budwood center and the secondary

blocks can only supply budwood for three years and are then renewed. Some secondary foundation trees are pruned and maintained as varietal evaluation trees.

The provincial budwood center and the disease-free nursery has produced 0.3 million budlings and 1.2 million buds annually since 1992. Thus far, 1.5 million budlings and 0.17 million containerized plants have been provided to the secondary mother foundation and commercial orchards.

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