ADVANCES ON CHESTNUT BLIGHT RESEARCH IN CHINA

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Abstract

Chestnut blight was one of the most notable diseases of forest on the world. Only as an example for pathogen attacking its host, it lead to the destruction of American chestnut tree. Chinese chestnut has a high resistant to the disease, with enlarge planting area it became a permanent threat to nut yield in China. For the reason, the distribution, characters and identification, diversity and control method were summarized in the article.

Key words: chestnut blight, *Crphonectria parasitica,* control, China, resistance

INTRODUCTION

The chestnut blight fungus, caused by *Cryphonectria parasitica* (Murr.) Barr is one of the major diseases of chestnut and has caused serious damage to orchards and forests in the world. *C. parasitica* was first identified in the United States in 1904, that had been introduced from either China or Japan, when lesions and necrosis were observed on trunk and branches of the American chestnut [*Castanea dentata* (Marsh) Borkh] leading to the destruction of this species (Anagnostakis, 1987). In 1913, the disease was observed in China, from then, it was been found in the most of Chinese chestnut growing areas. In 1938, the pathogen was first discovered in Europe near Genova, Italy (Biraghi, 1946). In Hungary chestnut blight symptoms were first identified in 1969 (Körtvély, 1970). Then symptoms of the fungus were also detected in the other parts of the Carpathian-basin, including Slovakia (Juhasova, 1976), Romania (Florea and Popa, 1989) and Ukraine (Radócz, 2001). Chestnut blight symptoms were also reported on oaks in the the Carpathian Basin, in Hungary at Zengővárkony (Radócz and Holb, 2002) and in Baia-Mare (Romania) (Tarcali and Radócz, 2006; 2007) although symptoms were not so serious on *Quercus petraea* than on *Castanea sativa* (Tarcali, 2007), *C. parasitica* is also a new serious potential danger for local oaks there (Radócz and Tarcali, 2009).

Chinese chestnut has a high resistant to *C. parasitica*, the canker often develop on branch or trunk, rarely girdles the stem; and the open canker, if not too large ,may be closed over by growing bark.

In the past twenty years, along with the sustained, rapid and multipole development of Chinese chestnut industry, the product and trade system of chestnut had been perfect step by step. However, the problem of chestnut blight was ignored; it became a permanent threat to nut yield. According to the character and distribution of chestnut blight, the biological control of chestnut blight, selection and breeding blight resistant cultivars, the study summarized the advances on chestnut blight research in China and put forward some suggestions to promote the sustainable development of Chinese chestnut protection.

DISTRIBUTION OF CHESTNUT BLIGHT

Cryphonectria parasitica, the causal agent of chestnut blight was first observed and identified by Frank Meyer at near San tun ying, Chili Province, China, June 1,

1913(Anagnostakis, 1992). The fungus was identified first in the USA on American chestnut [*Castanea dentata* (Marsh) Borkh] (Anagnostakis, 1987).

This disease mainly occurred in China at the Yellow River valley and the Yangtze River, including Beijing, Hebei, Shandong, Jiangsu, Anhui, Zhejiang, Henan, Hunan, Shaanxi, Sichuan and Hubei (*Figure 1*). All level symptoms of *C. parasitica* had different degree occurrence in different chestnut growing area. It was found that incidence of *C. parasitica* decreased gradually from north to south by field survey in China, among the three species of *Castanea* investigated, *Castanea mollissima* Blume showed the highest resistance to the chestnut blight, the disease incidence and severity increase with the aging of chestnut trees (Zhou, 1993; Liu, 2002).

CHARACTERS AND IDENTIFICATION OF CHESTNUT BLIGHT

The hosts most susceptible to the blight fungus are the American chestnut and the European chestnut (*Castanea sativa* Mill), the American being a little more so than the European. In China, there are three chestnut species named Chinese chestnut (*C. mollissima* Bl.), Henry chinquapin (*C. henryi* (Skan) Rehd.&Wilson.) and Chinese dwarf chinquapin(*C.seguinii* Dode)(*Figure 2*).All serve as hosts to the fungus, but show varying degrees of blight resistance(Zhou, 1993). Besides the fungus is widespread and continues to survive as post oak (*Quercus stellata*) and live oak (*Q. virginiana*).

Host infection occurs when fresh wounds in the bark become infected with spores that are disseminated by splashing rain, wind, and insects; over long distances, by birds. The fungus forms yellowish or orange fruiting bodies (pycnidia) about the size of a pin head on the older portion of cankers. Spores may exude from the pycnidia as orange, curled horns during moist weather. Reddish brown bark patches that develop into sunken or swollen and cracked cankers that kill twigs and limbs. Leaves on such branches turn brown and wither but remain attached for months. Gradually the entire tree dies. The fungus persists for years in short-lived sprouts from old chestnut roots and in less susceptible hosts (Zhou, 1996; Zhao, 2008).

Fig. 1: The region of chestnut blight mainly occured in China

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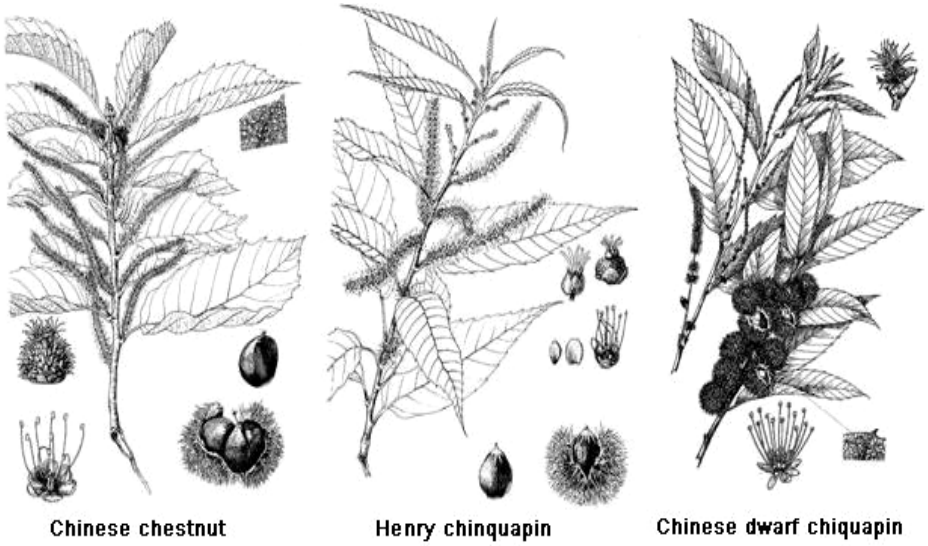

Fig. 2: The three chestnut species in China

China and Japan was considered to the origin of chestnut blight in the world. Using RAPD markers with the spatial autocorrelation analysis, the spatial structure of genetic diversity among 17 populations of *C. parasitica* in China was investigated and it speculated that Southwest China could be a possible center of *C. parasitica* origin in China (Yan, 2003). A significant diversity between *C. parasitica* populations had been found in the different chestnut growing areas in China. Fourty-one dsDNA viruses of chestnut blight isolated from eastern China were divided into five types that were more than the types of American and European fugues. According to cultural characters, the other five cultural types were divided that was not consistent with the types of dsDNA virus. The most of the tested isolates containing dsDNA viruses were hypovirulent (Xu, 2004).

The genetic structures of Chinese chestnut blight fungus were significantly subdivided in subpopulations while those from Japan were not. The populations were currently no gene flow between of Asia and USA, there was less differentiation between Japanese and American population and between Japanese and Italian populations than between Japanese and Chinese populations despite the fact that Japan was geographically closer to China (Wang, 2004; Xu, 2005; Xu, 2008).

Vegetative compatibility (VC) is a major obstacle to the diffusion of the hypovirus. There were three types of VC: strong incompatible pairing, faint incompatible pairing and middle incompatible pairing in China. The vegetative compatibility groups (VCGs) of the fungus in China were more complicated than that in other counties. 219 isolations from Jiangsu and Anhui provinces were divided into 131 VCGs, at least 8 VC genes could be estimated (Wang, 1991). Qin Ling (2001) collected the natural cankers on Chinese chestnut trees in Hebei and Beijing areas. 43 VCGs were divided and at least 6 VC genes could be estimated.

CONTROL OF CHESTNUT BLIGHT

Selection and breeding blight resistant cultivars is a great way to solve the damage of *C. parasitica*. As one of main species, Chinese chestnut has evolved a very successful resistance to the blight, probably more so than any other species of chestnut. Huang H W (1996) reported the chestnut cultivar of ‘Hongguang’ and ‘WanBoke’ had the highest blight

resistance to *C. parasitica*, they can be as the parents of backcrossing breeding. In north of China, the blight resistance of 21 local chestnut cultivars was compared, 'Beiyu No.2' and 'Xinlongcheng No.9' were the highest blight (Qin, 2002).

Current research is targeted toward finding a blight-resistant species and the further development of the hypovirulent strains of the fungus. These strains tend to inactivate the pathogen and promote healing, but only when applied directly to developing cankers. It was advanced and implanted in Europe. However, this method has not been as effective in China, Existence of many VCGs enables it to be unreality as well as onerous (Wang, 1997).

In view of the chestnut blight related with reproductive methods, the standing conditions, the geographical environments, the components of standing forest and the cultivation management of chestnut trees, improving the integrated chestnut management level will be an economical and practical method, just as putting out pathogenic contamination, avoiding the physical damage to tree body, increasing organic fertilizer and so on.

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