EXPERIENCES OF A STUDY TRIP IN CHINA ON THE RESEARCH OF CHESTNUT BLIGHT FUNGUS AND GALL WASP

Gabor Tarcali, Laszlo Radocz

Department of Plant Protection, University of Debrecen, Debrecen, Hungary,
tarcali@agr.unideb.hu

Abstract

Chestnut is widely cultivated in Asia. Chinese chestnut (Castanea mollissima Blume) is an important tree species in world chestnut production and the best source of resistance to Cryphonectria parasitica (Murr.) Barr, the casual agent of chestnut blight. Cryphonectria parasiticat was first identified in China in 1913. The chestnut gall wasp (Dryocosmus kuriphilus Yasumatsu) is the other major pests damaging chestnut. It is native in China. It was first reported in Japan in 1941. The chestnut gall wasp has been accidentally introduced to distant continents as North America and Europe. Its occurance in Europe was first recorded in Italy in 2002. In Hungary it was found in May 2009 on a single chestnut tree in Budapest.

Goal of our examination was to study the resistance of Castanea mollissima to the chestnut blight fungus. Field examinations were done on Chinese chestnut stands. The results showed that there are C. parasitica infections on every examined sites. Blight symptoms were detected on the Chinese chestnut trees, but there was not high degree of destruction. Susceptibility of Chinese chestnut and European chestnut to Cryphonectria parasitica were compared based on the results of the field examinations in China and in Hungary. Castanea mollissima has great resistance to the chestnut blight disease. European chestnut has not resistance to C. parasitica, and application of hipovirulent strains is one of the efficient protection method against this parasite. Resistance breeding programs are very important and it may be another method to prevent serious Cryphonectria parasitica damages. Another main goal of our trip to China was to study the Dryocosmus kuriphilus and its: biology ,characteristics and damages.

Keywords: *Castabea mollissima*, *Castabea sativa*, China, chestnut blight, *Cryphonectria parasitic*a, blight symptoms, resistance, *Dryocosmus kuriphilus*, gall wasp

INTRODUCTION

The history of Chinese chestnut cultivation could be as far as dated as 1,000 D.C up to the Han Dynasty (206 B. C.-A.D. 220). It became an important kind of economic trees at that time. The production of chestnut fruit has been gradually restored and developed since the founding of the People's Republic of China. Nowadays, chestnut has been a mainstay industry in many villages and towns of producing areas, and it will be a vast prospect in making rational use of land resources and promoting economical development in hilly and mountainous areas of the country. The chestnut is widely cultivated in China. The natural range of the Chinese chestnut extends from the far North of Jilin province is (north 40°26′) to the tropical region of Hainan province (18°30′) in China (Zhang et al, 1987). The main producing areas of Chinese chestnut are concentrated at the Yellow River valley and the Yangtze River valley. China is currently one of the most important chestnut producing countries in the World, with 130.000 hectares harvested chestnut trees. In 2007, the nut productions was 925.000 tons, took the top place in the World. In Beijing region, there was 41.667 hectares chestnut growing land in 2006. Chinese chestnut (*Castanea mollissima* Blume) is not only an important species in World chestnut production but the best source of resistance to *Cryphonectria parasitica* (Murr.) Barr (Graves, 1950).

LITERATURE

The fungus was introduced into North America from the East-Asia at the end of the XIX. th. century and spread within the next five decades throughout all the main chestnut areas. *C. parasitica* was identified first in the USA in 1904, when its symptoms were observed on American chestnut [*Castanea dentata* (Marsh) Borkh] leading to the destruction of this species (Anagnostakis, 1987). In 1938, the pathogen was first discovered in Europe near Genova, Italy (Biraghi, 1946). The fungus spread rapidly and at the end of the last century most parts of Europe were affected by the pathogen (Szabó, 2003), including Hungary where chestnut blight symptoms were first identified in 1969 (Körtvély, 1970). Then symptoms of the fungus were also detected on other chestnut growing areas of the Carpathian-basin, including Slovakia (Juhasova, 1976), Romania (Florea and Popa, 1989) and Ukraine (Radócz, 2001). In China, *Cryphonectria parasitica* was first identified at near San-tun-ying, Chili Province, 1st of June, 1913 (Fairchild, 1913). The incidence of *C. parasitica* in China decreased gradually from north to south. The disease mainly occurred at the valley of Yellow River and the Yangtze River, including Beijing, Hebei, Shandong, Jiangsu, Anhui, Zhejiang, Henan, Hunan, Shaanxi, Sichuan and Hubei provinces. Symptoms of the fungus had different degree occurrence in different areas of chestnut (Liu et al, 2002).

Although *C. parasitica* is endemic in all major chestnut-growing areas of China (Zhang et al, 1987), considerable variation in blight resistance has been reported (Headland et al, 1976; Zhao, 1980). Zhao (1980) surveyed 24 southern cultivars in the Nanjing area of China and found blight incidence to range from 0 to 63 %. Most infected trees remained productive despite of the infection by *C. parasitica*, and yields were reduced more by poor orchard management, nutrient deficiency, and other disease and insect problems (Zhang et al, 1987). Artificial inoculations and field observations of 12 *Castanea* species over a 30-year period showed the Chinese chestnut (*Castanea mollissima*) to be the most resistant to the chestnut blight (Graves, 1950). The disease incidence and severity increase with the aging of chestnut trees (Zhou, 1993; Liu, 2002) and it is important to use the best source of resistance in breeding programs.

The chestnut gall wasp (*Dryocosmus kuriphilus* Yasumatsu) is one of the major incest pests damaging chestnut. It is native in China. It was first reported in Japan in 1941 (Yasumatsu, 1951), and it had got its official name in Japan what is current now (Fukuda and Okudai, 1950). *Dryocosmus kuriphilus* belong to so-called "oak-gall wasp" (*Cynipi* tribus) of *Cynipidae* family (Melika et al., 2003). Several species of *Cynipi* tribus are native in Hungary, which live on *Quercus cerris* (Csóka, 1997, Melika et al, 2000).

It is reported that the rate of the pest damaging trees and buds are up to 100%, respectively, which leads yield loss over 80%. In China, the pest is widely distributes in many provinces and municipalities where there are the main chestnut productive areas. The chestnut gall wasp a main pest which often outbreak. It is clear that the pest is such a specialized parasitic insect living in the chestnut buds. Adults lay eggs in the buds. The buds of the chestnut tree cannot grow shoots and get seeds, and will grow ball-like galls in the next spring. When the infested bud breaks, larvae induce the formation of the gall; make stop the growth of shoots. This will lead to a poor production of the chestnut. The damage may continue for many years.

In the years around 1990, the damaged area was over 13 000 ha, which makes up 60% of total chestnut productive regions of the Jian'ou City of Fujian. The yield of infected plants in weight was about 20% of that of healthy plants; and the wasp even caused the death of some plants, resulting in heavy financial losses. In 1998, in Pinggu of Beijing, the ratio of damaged trees reached 96% and the ratio of damaged chestnut branches reached 70%. The yield loss was 30%. In 2004, the serious damaged area was over 333 hectares,

which makes up 71% of total chestnut productive regions in Shennongjia in Hubei Province (Feng et al., 2006).

According to the research history of chestnut gall wasp in China, as early as in 1929, damage records on chestnut were reported by Gao Zhulin. In 1952, serious damages on the chestnut gall wasp were found by Zou Zhonglin in Wangting of Jiangsu province when a large number of insects galls appeared. The chestnut gall wasp was reared and the samples were identified as *Dryocosmus kuriphilus* Yasumatsu.

The oriental sweet chestnut gall wasp (*Dryocosmus kuriphilus* Yasumatsu 1951) has been accidentally introduced to distant continents as North America and Europe. Its occurance in Europe was first recorded in Piemonte region, near Torino, Italy in 2002 (Brussino et al, 2002). It was expected that gall wasp will appear in Hungary soon (Melika et al., 2003). It was first found in Hungary in May 2009 on a young single chestnut tree in Budapest. It is possible that the tree was carried from Northern Italy (Csóka et al, 2009).

MATERIALS AND METHODS

Field investigations were done on 7 test sites in 5 chestnut growing areas of Beijing region, China, on 26-29 of August, 2009. Visual investigations were done to measure of damages caused by *C. parasitica* on Chinese chestnut (*Castanea mollissima*). Infection ratio (I%) were measured in the examined chestnut populations and infection index (Ii) were calculated according to a classification system (*Table 1*). The 5 examined areas were the follows: Huairou chestnut orchard, Miyun chestnut orchard, Changping chestnut orchard, Pinggu chestnut orchard and Yanqing chestnut orchard. During the field examinations bark samples for laboratory identifications and further examinations were collected from the infected trees with a disinfected sharp scalpel. In the laboratory PDA (potato-dextrose-agar) media were used for examinations.

Our goal was to study the resistance of *Castanea mollissima* to chestnut blight. The susceptibility of Chinese and European chestnut to *Cryphonectria parasitica* were compared based on the results of field examinations in China and in Hungary. Visual observations and studies *Dryocosmus kuriphilus* were also goal of the field examinations on the Chinese chestnut orchars.

Table 1.

Classification system (Ii = 1 - 5) degrees on chestnut (according to Radócz, 1998)

Infection degree	Damage of leaves (%)	Damage of bark tissue (%)
Healthy tree	0 %	0 %
I.	< 10 %	Max. 10 %
II.	11-25 %	Max. 25 %
III.	26-50 %	Max. 50 %
IV.	51-99 %	Max. 99 %
V.	100 %	Dead tree or dead tree with spear growing

RESULTS AND DISCUSSION

RESULT OF *CRYPHONECTRIA PARASITICA* INVESTIGATIONS

Previous results in China

The infection of *Cryphonectria parasitica* fungus is the main plant pathological problem for chestnut growing areas in Beijing, Hebei, Liaoning, Shandong, Jiangsu, Anhui, Zejiang, Henan, Hunan, Guangdong, Guangxi, Shanaxi, Hubei, Fujian, Sichuan. The incidence of disease in 7 locations form Shanaxi, Hebei, Beijing and Hubei were from

21,2% - 33,3%. In China, 131 VCG-s from 219 isolates of *C. parasitica* fungus were identified (Wang et al., 1991).

The spatial structure of genetic diversity among 17 populations of *Cryphonectria parasitica* in China was investigated using RAPD markers with the spatial autocorrelation analysis. The result revealed a lack that genetic variations of the most polymorphic loci were randomly distributed. However, cline depression, lump, or double cline structures of the genetic variation were found at some RAPD loci with significant Moran's in several distance classes. The spatial patterns of genetic differentiation in populations appeared to be a combining result of long-distance gene flow, human activities, local effects of geographic isolation and reproduction behaviour of *C. parasitica*, and it speculated that Southwest China could be a possible center of *C.parasitica* origin in China based on the cline pattern at some loci (Yan et al., 2003).

Field examinations results in China and in Hungary

Field examinations on Chinese chestnut stands showed that there are *C. parasitica* infections on every examined sites. Blight symptoms (*Figure 7-8*) were detected on the Chinese chestnut trees, but there were not a high degree of destruction. Infection ratio (I%) and infection (Ii) index were measured on each test sites. The infection ratio (I%) ranged between 14–34 % on the 7 examined chestnut stands (*Table 2*). Most of the symptoms were in the I. infection degree (it is the less heavy infection), but there were some in the II. and in the III. infection degree, which represented more serious infections. 3 chestnut trees were found on the 7 test sites with the infection degree IV. These trees were infected very seriously. There were not found any killed Chinese chestnut (*Castanea mollissima*) trees because of *Cryphonectria parasitica* on the examined chestnut fields in the Beijing region. The result showed the great resistance level of *Castanea mollissima* to the chestnut blight disease.

Table 2.

Results of field examinations on Chinese chestnut (*Castanea mollissima*) in Beijing region, China

Chestnut growing areas (test sites)	Time of field examinations	Number of examined trees	Infection degree						Ii	I%
			Healthy tree	I.	II.	III.	IV.	V.		
HUAIROU chestnut orchard I.	26.08.2009.	100	66	12	14	7	1	-	1,91	34
HUAIROU chestnut orchard II.	26.08.2009.	100	68	13	11	8	-	-	1,84	32
MIYUN Chestnut orchard I.	04.09.2009.	100	80	6	11	4	-	-	2,00	20
MIYUN Chestnut orchard II.	04.09.2009.	100	74	11	8	7	-	-	1,85	26
CHANGPING chestnut orchard	28.08.2009.	100	78	5	12	12	2	-	2,35	31
PINGGU Chestnut orchard	02.09.2009.	100	86	5	5	4	-	-	1,93	14
YANQING chestnut orchard	23.09.2009.	100	76	13	8	3	-	-	1,58	24

On the other hand the results in Hungary (and moreover results from other growing areas of the Carpathian-Basin) showed that there are more significant *C. parasitica* destructions on European chestnut (*Castanea sativa*). In the Carpathian-Basin higher infection rate (F%) with higher degrees of damages (Ii) can be found in *Table 3*. Also several chestnut trees were killed by the *C. parasitica fungus* there. European chestnut has

not resistance to chestnut blight disease. This comparison of field results showed the differences between the resistance level of *Castanea molissima* and *Castanea sativa* to *Cryphonectria parasitica* fungus.

Although applying hipovirulent strains is the one efficient protection method against chestnut blight in Europe, resistant breeding programs are very important and it may be another way to prevent serious *Cryphonectria parasitica* damages.

Table 3.

Results of field examinations on European chestnut (*Castanea sativa*) in the Carpathian-Basin

Chestnut growing areas (test sites)	Time of field examinations	Number of examined trees	Infection degree						Ii	I %
			Healthy tree	I.	II.	III.	IV.	V.		
Cák (HU)	20.05.1994	100	55	15	11	10	4	5	2,40	45
Csepreg (HU)	19.04.1994.	100	32	14	13	12	14	15	3,04	68
Velem (HU)	20.04.1994.	100	39	15	17	7	9	13	2,80	61
Nemeshetés (HU)	21.04.1994.	100	22	13	18	17	18	12	2,97	78
Sand (HU)	19.10.1994.	100	31	17	19	10	12	11	2,72	69
Gödöllő (HU)	06.07.1994.	100	40	13	16	16	13	4	2,68	60
Zengővárkony(cemetery)(HU)	24.07.1997.	100	7	12	16	17	21	27	3,38	93
Zengővárkony(Kócsid) (HU)	01.06.1997.	100	34	15	12	17	10	12	2,88	66
Sopron (Fáber-rét) (HU)	29.03.1995.	100	49	13	9	11	9	9	2,84	51
Sopron (Bánfalva) (HU)	28.05.1996.	15	0	-	-	-	-	-	-	100
Fertőszentmiklós (HU)	29.03.1995.	100	11	21	22	16	19	11	2,74	89
Baia Mare-Veresvíz (RO)	08.11.2006.	100	5	5	6	7	8	69	4,47	95
Bobivisce IV. (UA)	27.07.2009.	100	2	6	11	29	22	30	3,60	98

Remarks:

HU - Hungary
RO - Romania
UA - Ukraine

RESULT OF *DRYOCOSMUS KURIPHILUS* STUDIES

Biology and characteristics of chestnut gall wasp

Life Cycle

Chestnut gall wasp has one generation annually in the mainland of China (Shandong, Henan, Chongqing and other areas) It overwinters as a small larva in the bud of the host plant. The larva feeds in the bud during chestnut shooting in the following spring, which leads to form a hard insect gall gradually instead of growing on the damaged shoots, leaves or buds. Each gall has 1-5 pest rooms and can hosts 1-16 larvae. 2 to 5 larvae were observed in each gall in most cases. The larva lives in the gall for 30-70 days, generally for 50 days (Ding et al., 2004).

The occurrence and damage activities of the chestnut gall wasp have close relations with chestnut phonologic phases (Ao et al., 1980). The overwintered larvae began to feed following with chestnut bud beginning to sprout in spring. The larvae in the bud grow and develop rapidly accompanying the shooting of their host chestnut buds. During the male flower initial bloom stage the larvae of the wasp get into pupation. At the and of the male flower blooming of host tree the pests in the galls develop into adult stage. About 15 days later, the wasps get into the reproductive period. When getting out off host galls the adults are ready for ovideposition. Under natural conditions, the zooecium number was positively related to the quality and volume of the gall (Ding et al., 2004).

Chestnut gall wasp occurrence is observed cyclically and regionally throughout mainland of China. It was said that the regulation of its natural enemies is the main reason,

mainly of its parasitic wasps. There was such phenomenon that if a heavy damage in practice with an outbreak of the pest lasted for 2-3 years, then the pest occurred just mildly in scale for about 10 years (Zu, 1993,).

In Shandong, Henan, overwintering larvae of the wasp began to be active and growing rapidly from early April. The pupation of the wasp is observed from mid-May to late June. Emergence of its adults occurs from late May to the end of June. The insect forms galls since late April. After its emergence the adults stay about 10 days in the gall and complete the development of ovaries during this period. They then bite a hole and get out off the host gall, from early June to early July. Female adults ovidepost their eggs in the buds parthenogeneticly. Since the August the larvae hatch, feed, and form a larger zooecium in the bud, which will develop into shoot, leaves, flower next year. Since the mid-September they gradually get into overwinter stage and spend the whole winter in the zooecium (Jin et al., 1995, Li et al., 2003).

Habitat

The adults stay about 10-15 days after the emergence stage in the galls before they get out. After getting out off the gall, the adults begin to lay parthenogenetic eggs; they are mostly found from 6 to 11 am. The habits of supplementary nutrition of the adult was not found but it shows phototaxis to black light lamps. The eggs are mostly laid in chestnut buds, generally the last 5-6 buds down from the top bud. Each bud has 1-10 eggs, usually two or three. Duration of eggs is about 15 days. Over 90 % of eggs are laid into the upper half side of a bud, and about 80% are located above the growing point, which would lead to the production of a gall instead of a branch. Some eggs are laid into edge side of growing point and would lead a weak stick with a gall. Eggs are laid on rudiment would lead insects gall in the vein of leaves (Sun and Fan, 1965, Li et al, 2003).

The natural enemies of chestnut gall wasp

Almost all of the natural enemies of chestnut gall wasp are the larvae stage parasitic wasps, in which 28 species have now been found (Guo et al, 1997). They are belonging to 12 families such as Torymidae, Eurytomidae, Ormyridae, Encyrtidae, Eupelmidae and so on. Among the parasitic wasps of chestnut gall wasp, the minority is kinds of monophagous parasitic wasps such as *Torymus sinensis* Kamijo, *Ormyrus* punctiger Westwood, and the majority is kinds of oligophagous parasitic wasps such as *Torymus geranii* Walker and *Eupelmus urozonus* Dalman, which are mainly parasitoids of the gall-making insects on the plants of beech family Generally more than 10 kinds of initial parasitoids such as *Torymus sinensis* Kamijo and *Megastigmus nipponicus* Kamijo are hosted in phytophagous insects. About 5 to 8 kinds of them such as *Eurytoma variegate* Cuvtis and *Eurytoma decatoma* Concinna were epiparasitism parasitoids (*Table 4*).

Table 4

The recorded natural enemies of chestnut gall wasp

Scienfitic name	**Known distribution**
Torymus sinensis Y. et K.	China
Torymus geranii (Walker)	China, Japan, Korea, Europe
Torymus koreanus Kamijc	Korea
Torymus beneficus Y. et K.	Japan
Megastigmus nipponicus Y. et K	Japan, Korea
Megastigmus maculipennis Y. et K	China, Japan, Korea
Eurytoma brunniventris R.	China, Japan, Korea, America
Eurytoma setigera Mayr	China, Japan, Central-Asia,Europe
Eurytoma schaeferi Y. et K	Japan
Sycophila variegate (Curtis)	China, Japan, Korea, Europe
Ormyrus punctiger W.	China, Japan, Korea, Europe

Ormyrus flavitibialis Y. et K	Japan, Korea
Eupelmus urozonus Dalman	China, Japan, Korea, Central-Asia Europe, North-Africa
Peleumus ferrierer Y.	Japan
Eupelmus spongipartus F.	China, Europe, Russia
Cynipencyrtus flavus Ishii	Japan
Pteromalus apantelpohagus C.	Japan
Amblymerus amoenus japonicus Y.	Japan
Tetractishus sp.	Japan, China
Apsilota yasumatsui	Japan

Sun (1965) reported a kind of adult parasitic wasps of the chestnut gall wasp in vitro. The larva of the pest was parasitized by Diptera insects. Yamamoto (1987) found that three kinds of hymenoptera adults were emerged from the Chestnut Gall, including species of Ceraphronidae (shield small-bee), Bethylidae (bethylids) and *Elaehertus* sp. (Scarcity Festival Wasps), whether they were the parasitic natural enemies of chestnut gall wasp or not, had not been confirmed. According to another report (Forestry Farming Bureau of Forestry Ministry, 1980), the natural enemies of chestnut gall wasp also included a kind of weevil, a spider and a pentatomid bug.

Among lots of parasitic natural enemies of chestnut gall wasp, *Torymus sinensis* Kamijo was the dominant specific parasitic natural enemy in many areas (Luo, 1985, Yan, 1995). The nearer *Torymus sinensis* Kamijo was to North, the more obvious the advantage was (Luo et al., 1986). There were certain differences in the dominant species in different region. According to the survey, in the damaged area by chestnut gall wasp, they were distributed both in Hebei Province and in Beijing, with a generation per year. The mature larvae overwinter in the parasitic dry galls of last year. The larvae overwintered would begin to pupate in mid-February, hatch in mid-April, and adult emergence in early May of next year (Dai and Lin, 2000).

After mating the adults of Torymidae Wasps find the new developed galls with the larvae of chestnut gall wasp, then insert their ovipositor into the chestnut gall, lay eggs in the inner wall of the zooecium of the pest, chestnut gall wasp. One or two days after hatching, its larva break the tegument of chestnut gall wasp larva with its large jaw, and suck their body fluids to live. Generally, one Torymidae Wasp larva is only hosted in one chestnut gall wasp larva. In Changping, Huairou, Miyun County, and other areas in Beijing, the ratio of chestnut gall wasp hosting parasitic natural enemies was 0.9 to 1.5% in 1978, when the ratio of the destroyed new shoots was 60.5 to 90.0%. In 1979 the ratio of damaged shoots was 23.9 to 54.2%, but the ratio of the destroyed new shoots declined to 30.5% comparatively. It was also reported that the ratio of chestnut gall wasp hosted by parasitic natural enemies was 24.23% in 1978 and 81.15% in 1980 respectively; the ratio of damaged shoots was 56.83% in 1978 and 9.9% in 1980 respectively in chestnut-producing areas in Qianxi County of Hebei Province (Zu, 1993, Dai and Lin, 2000).

Control management of the chestnut gall wasp in china

A lot of job has been done on the IPM (Integrated Pest Management) of the chestnut gall wasp in China. Liu et al. (2000) reported chemical control technologies. Huang et al. (1988) and Zhang et al. (2002) reported their research results on the application of classification, biology of the natural enemies of the chestnut gall wasp. Li et al. (2003) reported the physical and chemical resistance of the host trees against the chestnut gall wasp. At this moment it is considered that to control chestnut gall wasp the methods of agriculture should be used as the basement, keeping and utilizing the natural enemies should be considered before using chemicals. The main guidelines of the IPM are as follows:

Strengthening Quarantine

Transporting nursery stocks and scions from infected areas to the new chestnut development areas is forbidden, to prevent the proliferation of the chestnut gall wasp (Jin et al., 1995).

Strengthening the Management of Trees

To improve soil for nourishment, to culture root mass, to promote the growth of crown are good methods to strength the trees. Mean swell, breeding of insect-resistant chestnut is a basic method. There are different resistance sources to the chestnut gall wasp in different kinds of chestnut cultivars: Firstly, in the adult phase of chestnut gall wasp, chestnut gall wasps do not like to lay eggs on the shoot buds which grow so slowly that avoid the favorite period of the pest. This is named avoidance in resistances. Secondly it is difficult for a chestnut gall wasp to lay eggs on kinds of chestnut with slim buds with outer layer flakes hugged closely, which is seemed as insect-resistance. Thirdly, it is well known that the shoots of susceptible variety lure chestnut gall wasp adults to lay egg because they contain such chemicals that induce chestnut gall wasp adults into laying eggs. (Ding et al., 2004, Wu, 2005).

Agriculture Control

Prevention and control measures widespread carried out in orchards are as follows: winter pruning to decreasing the number of the overwintered chestnut gall wasp. Artificial destroying gall in the begging of new gall in the spring, placing overwinter dry gall cut last year in chestnut orchard to keep the parasitoids to control chestnut gall wasp and so on. The way to control withered gall through continuous annual winter pruning has been proved to be the best one combining with various measures in building forestry. After the practical application of it, the rate of controlling can come to 97.55% (Wei, 1990).

Physical Control

Using black light lamp tolure and kill adults of the chestnut gall wasp from early June to September every year. Setting up a lamp per 667 m² chestnut orchard can lure and kill the adults partly (Guo and Liu, 1992).

Biological Control

Using the parasitoids that can parasitize the chestnut gall wasp gall larvae is the best way for biological control. After winter pruning, preserving the dry gall and transferring them to a cage mask, which can keep lots o the natural enemies, then placing them into chestnut orchard in April to May next year. After all parasitoids are entirely emerged, the dry galls are burned (Huang et al., 1988).

Chemical Control

It is proved that spraying systemic insecticides such as methamidophos and omethoate is good at adult control of chestnut gall wasp. It can be used from the start to the top peak period with a 6-7 days interval. Totally two to three continuous times can significantly reduce the insect population density the next year. Meanwhile in the red stage of the buds to the stage of leafing of chestnut, injecting 1 ml the systemic insecticides into a hole, totally 3-6 holes depending on the diameter of stem, can prevent and treat the overwintering larvae in shoots. In some experiments the results showed also brushing branches using 50% methamidophos, 40% omethoate or phloem after the bark spread with 40% water solution had good effect to control gall wasp larvae in chestnut. These methods were basically non-injury to chestnut, and also effective to control other pests with piercing-sucking mouth parts on chestnut trees (Liu et al., 2000)

CONCLUSIONS

In China, *Cryphonectria parasitica* is an endemic parasite on Chinese chestnut, and blight symptoms were detected on the examined growing areas. However there are not so

high degree of destruction and the *Castanea mollissima* trees show great resistance to the chestnut blight disease. European chestnut has not resistance to *C. parasitica* fungus. In Europe, application of hipovirulent strains is the one efficient protection method against this blight fungus on *Castanea sativa*. However resistant breeding programs are very important and it may be another way to prevent serious *Cryphonectria parasitica* damages. The chestnut gall wasp (*Dryocosmus kuriphilus* Yasumatsu) is one of the major incest pests on chestnut in China. It is reported that the rate of the pest Damaging causes by this pest are very serious, which leads yield loss over 80% in China. Gall wasp was also found in Hungary in May 2009. and it can be a new dangerous pest chestnut in our country too.

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