

INTEGRATED PEST MANAGEMENT OF TEA GARDENS IN CHINA

Baoyu Han Dan Mu Hua-gang Qin

Tea Research Institute of Chinese Academy of Agricultural Sciences, Hangzhou, 310008 China

Yunqi Road 1, Hangzhou 310008 China Tel: +86-571-86650425 Email: han-insect@263.net

Summary

More than 800 species of pests and less than 100 species of diseases have been recorded in Chinese tea gardens. The economic thresholds of the important pests have been laid down, whose population densities are controlled below the economic threshold by means of the concerted application of agricultural control, biocontrol, chemical control, physical and mechanical control and plant quarantine. It has been recorded that over 200 species of parasitic natural enemy insects, more than 300 species of predatory natural enemy insects, more than 300 species of spiders, more than 80 species of entomopathogenic virus, 1 species of entomopathogenic bacteria, and 44 species of entomogenous fungi. The number of insecticide kinds used in non-pollution tea gardens are more than 30. The infochemicals lure devices are developed and used to trap tea green leafhopper, etc. And the control efficiency of the infochemicals lure devices to citrus spiny whitefly is more than 95 %. The natural enemy infochemicals attracting devices are applied to attract braconids to parasitize larvae of tea geometrid. Moreover, the ecological regulation measures, i. e. intercrop and so on are applied to restrain pests and prop up natural enemies.

Key words: tea plant pests; natural enemy insects; entomopathogenic virus; entomogenous fungi; spiders

Introduction

Up to the end of 2006, Chinese tea garden area was 15,000,000 ha. The tea plant cultivating history lasts for over 5000 years. The various tea garden communities distribute in the mountains, on the foothills and the plains. 808 species of pests and 65 species of diseases are recorded, in which 40 – 60 species of pests and 2 – 4 species of diseases frequently occur. During the past several dozens of years, the pests and diseases were suppressed by IPM techniques including agricultural control, chemical control, biological control, etc. The agricultural control (plucking, pruning, plough, etc.) acts as base measures, biocontrol acts as key measures, and chemical control as emergency measures. Lots of the entomopathogenic viruses and entomogenous fungi preparations have been applied into non-pollution tea gardens and organic tea gardens. The insect infochemicals began to be used to control important pests.

1 Main tea plant pests

Leaf-feeding pests include several hundred species of pests, in which the important chewing pests are as follow: tea tussock moth *Euproctis pseudoconspersa*, tea geometrid *Ectropis obliqua*, tea bagworm *Cryptothela minuscula*, tea eucleid *Iragoides fasciata*, smaller tea tortrix *Adoxophyes orana*, tea leaf roller *Caloptilia theivora*, tea weevil *Myllocerinus aurolineatus*, tea leaf beetle *Demotina fasciculata*, tea horned breast leaf beetle *Basilepta melanopus*, etc. The important piercing-sucking pests are as follow: tea green leafhopper *Emoasca vitis*, *Emoasca flavescens*, tea aphid *Toxoptera aurantii*, citrus spiny whitefly *Aleurocanthus spiniferus*, green mirid bug *Lygus lucorum*, tea mosquito bug *Helopeltis* sp., tea yellow thrip *Scirtothrips dorsatus*, green broad-winged planthopper *Geisha distinctissima*, pear white scale *Lopholeucaspis japonica*, Japanese wax scale *Ceroplastes japonicus*, horned wax scale *Ceroplastes ceriferus*, and red wax scale *Ceroplastes rubens*. The important mites are tea pink rust mite *Acaphylla theae*, tea yellow mite *Polyphagotarsonemus latus*, and coffee red spider mite *Oligonychus coffeae*. The important boring pests are Chinese tea-oecophorid *Casmara patrona*, and tea xylorictid *Linoclostis gonatias*, tea longhorned beetles *Aeolesthes induta*, tea stem girdler *Agrilus* sp., and tea shot-hole borer *Xyleborus fornicatus*. The most of underground pests are copper green chafer *Anomala corpulenta*, giant cricket *Brachytrupes portentosus*, african mole cricket *Gryllotalpa Africana*, and formosan white termite *Odontotermes formosanus*. The most seed pest is tea seed weevil *Curculio chinensis*.

2 Main tea plant diseases

The less than 100 species of diseases have been recorded. The most leaf diseases of tea plants are tea anthracnose *Gloeosporium theae-sinensis*, tea blister blight *Exobasidium vexans*, tea white scab *Phyllosticta theae folia*, tea bud blight *Phyllosticta gemmiphliae*, tea brown blight *Guignardia camelliae*, tea grey blight *Pestalotiopsis theae*, tea exobasidium blight *Exobasidium reticulatum*, tea brown leaf spot *Cercospora theae*, and tea sooty mould *Neocapnodium theae*. The most stem diseases of tea plant arec tea red rust *Cephaleuros parasiticus*, tea shoot blight *Cenangium* sp., tea horse hair blight *Marasmius equicrinis*, tea lichens *Alectoria* sp., tea mosses *Frullania* sp., *Barbella* sp., tea Cuscuta *Cuscuta japonica*, and tea mistletoe *Viscum albrum*. The most root diseases of tea plants are tea seedling blight *Pellicularia rolfsii*, and tea seedling crown gall *Agrobacterium tumefaciens*. The flower diseases of tea plants is tea flower blight *Botrytis cinerea*.

3 Biological control

3.1 Natural enemy resources

Over 200 species of parasitic natural enemy insects, more than 300 species of predatory natural enemy insects, more than 300 species of spiders, more than 80 species of entomopathogenic virus, 1 species of entomopathogenic bacteria, and 44 species of entomogenous fungi. The important natural enemy insects are as follow: *Coccinella septempunctata*, *Leis axyridis*, *Plopylaea japonica*, *Cicindela chinensis*, *Apanteles* spp., *Aphidius* sp., *Xanthopimpla punctata*, *Brachymeria lasus*, *Anicetus ceroplastis*, *Pediobius* spp., *Aphytis* sp., *Telenomus* sp., *Trichogramma confusum*, *Exorista sorbillans*, *Chrysopa sinica*, *Agriosphodrus dohrni*, *Mantis religiosa*, The most syrphid are *Sphaerophoria menthastris* and *Syrphus corollae*, etc.

The most spiders are *Coleosoma octomaculatum*, *Erigonidium graminicolum*, *Singa hamata*, *Agelena labyrinthica*, *Oxyopes sertatus*, *Xysticus ephippiatus*, *Misumenops tricuspidatus*, *Evarcha albaria*, and *Plerippus paykulli*, etc.

The most entomopathogenic virus are *Euproctis pseudoconspersa* NPV, *Ectropis oblique* NPV, *Adoxophyes orana* GV, *Euproctis pseudoconspersa* CPV, etc.

The most entomogenous fungi are *Zoophthora radican*, *Cordyceps militaris*, *Septobasidium pedicellatum*, *Beauveria bassiana*, *Paecilomyces* spp., *Aschersonia aleurodis*, etc.

3.2 Traditional biological control

Derate the application of chemical insecticides so as to avoid killing natural enemies. According to the economical threshold, leave a little quantity of pests to act as transferring hosts for the natural enemies. Protect and utilize and transfer the natural enemy insects and spiders. Reproduce and release *Trichogramma* spp. to suppress tea tortrix *Adoxophyes orana*, etc. During the population peak stage, entomogenous fungi, entomopathogenic virus and entomopathogenic bacteriae preparations were spayed to control the pests.

4 Agricultural control

Timely and frequently plucking can restrain pests which feed the tender tea shoots a certain extent. While pruning tea rows, the tea branches damaged by pests and diseases should be cut out. Under applying fertilizer and ploughing, the adult larvae and pupae within rhizosphere may be eliminated. Properly applying fertilizer can boost up tea plants against pests and diseases. Appropriately intercropping or growing overshadowing trees can augment biological diversity, and strengthen ecological control.

5 Chemical control

The pesticides are prohibited in organic tea gardens and AA-grade green food tea gardens. Certain insecticides were permitted to be used in A-grade green food tea gardens; however, the merchant teas in this kind of tea garden must be eligible to the green food standard of China, and MRL of insecticide residues in teas do not surpass the standard of tea importing countries.

6 A example: Integrated management of citrus spiny whitefly

At first, the population percentage within upper, middle and lower layers of tea clumps were 11%, 28% and 61%. Most of adults and eggs within the upper layer may be plucked off. The second, the 1-2 instar larvae of the first generation occur in the early and middle May, and the 2-3 instar larvae of the fourth generation occur in the middle and late October. During the two periods, if the population density surpasses the economic threshold, some insecticides are spayed. The third, The “mould rain” period occurs in the middle and late May, and autumn rain period occurs in the middle and late September and early October. It is rainy. If the population density is high, the preparations of *Aegerita webber* or *Aschersonia aleyrodis* are released to control the pests. The last, the adults of the whiteflies emerge largely from the end of March to the early April. The infochemicals lures are used to trap the adults in spring tea period, and the control effect has been more than 98 %. Through the combining application of these control measures, the whitefly can be controlled effectually.

7 Control of tea diseases

In Chinese tea gardens the diseases are not serious. Tea Anthracnose *Colletotrichum theae-sinensis* Miyake damages several Longjing cultivars a little.

8 Prospect

In China, the area of tea gardens still extend. The amount of chemical insecticides will be restricted. More insect infochemicals preparations and entomopathogenic microbe preparations will be used in pest management.

Acknowledgements

This work is supported by the research project (2006BAD06B01) and 948 project (2006-G16A).

References

- Chen Y F, Song C Q, Liu L M, Ye H X, Wu L T, Xiu H Z. Studies on species of spiders in tea garden in China. *Journal of Tea Science*, 2000, 20(1): 59 –60 (in Chinese with English abstract)
- Han B Y, Cui L. Natural population life table of citrus spiny whitefly (*Aleurocanthus spiniferus*) in tea garden. *Acta Ecologica Sinica*, 2003, 23 (9): 1781 – 1790 (in Chinese with English abstract)
- Han B Y. Difference in dynamic and structure of spider communities in organic and non-pollution and common tea gardens. *Acta Arachnologica Sinica*, 2005, 14 (2): 104 –107 (in Chinese with English abstract)