

An overview of occurrence, development and damage of bamboo mites and their integrated management in Fujian, China*

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Abstract

This paper gives an overview of the occurrence of mite pests (*Schizotetranychus nanjingensis* Ma & Yuan, *Aponychus corpuzae* Rimando and *Aculus bambusae* Kuang) and their damage to the moso bamboo (*Phyllostachys pubescens*) in Fujian province, China. The effects of mites on the physiology of the plants and their yield are briefly discussed. Possible causes of their outbreaks in bamboo forests are outlined. A schematic model for the integrated management of bamboo mites is proposed.

Key words: Bamboo (*Phyllostachy pubescens*), mites, outbreak, integrated management

Introduction

Fujian province is located in the southeast coast of China. It covers an areas of 123,000 km², 95% of which are mountains and hills.

* This paper is based on an invited talk given by the senior author at the "4th International Symposium on Population Dynamics of Plant-Inhabiting Mites" held in Kyoto, Japan in May 1999.

Fujian has some 680,000 acres of the moso bamboo (*Phyllostachys pubescens*). This is one quarter of the moso bamboo in the world. The economic development in coastal areas of China since the mid-1980s has resulted in a great number of buildings being constructed, and these have caused a great demand for the moso bamboo, the culm of which is used for scaffolding. Other increased demands also stimulated the growth of bamboo forestry in Fujian: the use of bamboo in bed sheets and furniture, floors in houses, and bamboo shoots as food.

Since the late 1980s, the bamboo forestry has become one of the five main supporting business in Fujian. Bamboo forestry has become a major income for local governments and farmers in mountainous areas. The annual revenue from the bamboo forestry in Fujian reached 1.2 billion yuan or 140 million US dollars in recent years.

In 1990, our surveys revealed that spider mites (*Schizotetranychus nanjingensis* Ma & Yuan and *Aponychus corpuzae* Rimando) and a rust mite (*Aculus bambusae* Kuang) were causing damage to the moso bamboo in Fujian. In 1994, outbreaks of mites occurred in some major bamboo production areas. By 1998, these mites were found in sixty-three counties/cities/districts. In some areas only one species was present, but in most areas, mixed populations of mites were common (Zhang *et al.* 1998a). The mite problems in Fujian were more severe than earlier reports of damage to bamboo plants by *Schizotetranychus* mites in Zhejiang (Yu & Shi 1990) and Shandong (Sun *et al.* 1997).

Our survey of bamboo forests in 63 counties/cities/districts in 1998 showed that 5% of them were heavily damaged, 30% of them were moderately damaged, 40% of them were lightly damaged and 25% of them were not infested (most of these forests were natural mixed forests at high altitudes with a single mite species).

Mite feeding reduced the chlorophyll content in bamboo leaves. *Schizotetranychus nanjingensis* feeding reduced it by 11% with light damage (1-3 nests per leaf), 24% with moderate damage (4-10 nests per leaf), and 57% with heavy damage (11-20 nests per leaf or more) (Zhang *et al.* 1998b). *Aponychus corpuzae* feeding reduced it by 11% with light damage (5-10 mites per leaf), 58% with moderate damage

(33.4-48.5 mites per leaf) and 63% with heavy damage (65.8-80.0 mites per leaf) (Zhang *et al.* 1998c).

Mite feeding also reduced the sugar content in bamboo leaves. *Schizotetranychus nanjingensis* reduced it by 2% with light damage, 13% with moderate damage, and 55% with heavy damage (Zhang *et al.* 1998b). *Aponychus corpuzae* reduced it by 5% with light damage, 12% with moderate damage, and 51% with heavy damage (Zhang *et al.* 1998c). Likewise, mite feeding also reduced the total sugar content in bamboo leaves. *Schizotetranychus nanjingensis* reduced it by 12% with light damage, 19% with moderate damage, and 57% with heavy damage (Zhang *et al.* 1998b). *Aponychus corpuzae* reduced it by 3% with light damage, 39% with moderate damage, and 67% with heavy damage (Zhang *et al.* 1998c).

The contents of 18 amino acids and water were also noticeably reduced by mite feeding (Zhang *et al.* 1998b,c).

Damaged plants have abnormal physiology and metabolism. Bamboo plants normally change leaves every other year. Damaged plants might change leaf every year, or even twice each year.

Mite damage significantly reduced the leaf areas of bamboo plants by 30% with light damage and by 58% with heavy damage (Zhang *et al.* 1998b,c). A noticeable result was that new culm became thinner and longer. Our investigation showed that an acre of lightly damaged forest lost 20-30% new culm (300-450) with a loss of 3750 kilograms of shoots, moderately damaged forest lost 30-40% new culm (450-600) and heavily damaged forests looked burnt from a distance.

Mite damage to bamboo forests has affected the economy, ecology and biodiversity of Fujian province.

Fujian government and many scientists have paid great attention to the occurrence, development and damage of bamboo mites. The project "Studies on biology of phytophagous mites and their integrated management" became a key project of Fujian Science Council during the 1996-1999 period, and "Using predatory mites to control pest mites of bamboo forests" became another key project of Fujian Science Council during the 1999-2001 period.

Mite occurrence, development and damage

Before 1985, the bamboo plants were mixed with other trees in polyculture natural forests. There were only 750 bamboo plants in a hectare. After 1986, most natural bamboo forests were changed into artificial monoculture forests to increase production. The number of bamboo plants was increased to over 2000 in a hectare in some areas. Over-harvesting caused diseases and pest outbreaks in some forests. The use of some pesticides for chemical control killed natural enemies. We observed 30 natural and 30 artificial bamboo forests. The results showed that natural polyculture forests had 5-10 times as many natural enemies (especially predatory mites of the Phytoseiidae) as artificial monoculture ones, where the underfloor lower plants were cut, soils were turned and plant growth hormones were used. These cultural practices resulted in monoculture, ecologically unstable and weakened forests which are more susceptible to pest outbreaks (Fig. 1).

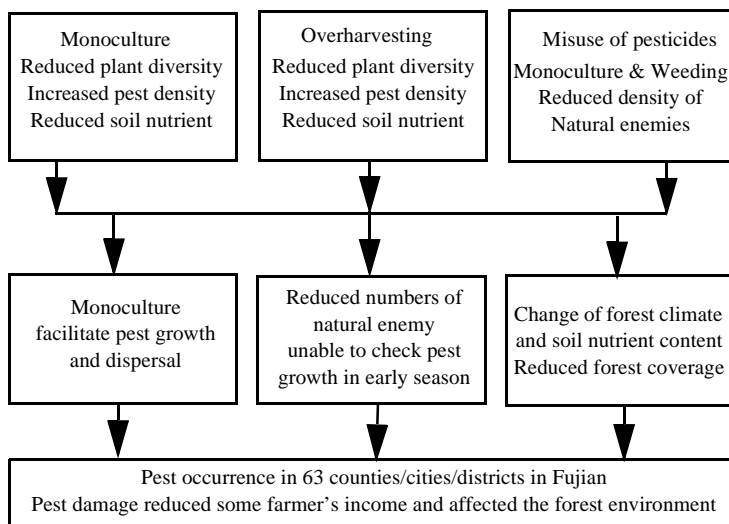


FIGURE 1. Schematic analysis of occurrence, development and damage of bamboo mites in Fujian.

Integrated forest and pest management

Since 1996 we have conducted investigations at main bamboo growing areas in Fujian and analyzed the occurrence and development of pest mites. We proposed the following management practices to restore forest health and reduce/prevent pest damage in the long term: (1) changing monoculture bamboo forests into polyculture ones, (2) promoting healthy bamboo culture, and (3) increasing natural enemies of pest mites.

In seriously damaged areas, we advised farmers to cut diseased/damaged bamboo plants, burn them and re-introduce other trees to increase plant diversity in the forests. In moderately damaged areas, we reduced pest mite densities efficiently by 94-98% in 30 days with selective injections of solutions of systemic pesticides (50% methamidophos, 40% omethoate, 20% fenvalerate, 20% methomyl, or 50% chlorfluazuron diluted by 10-30 times) into joints on the culm.

To establish sustainable and ecological pest management system in bamboo forests, we first interplanted broad leaf trees with the moso bamboo at about 2:8 or 3:7 ratios to resume the biodiversity of bamboo forests. Secondly, we established healthy culture in bamboo forests to increase their natural resistance to pests and diseases, and the compensatory ability of bamboo plants. Since 1997 we have made a great deal of efforts in using “organic” fertilizers (fermented sugar-cane byproducts) mixed with N, P, K, Mn, Zn and Si elements to boost the growth of bamboo plants. We mixed these fertilizers with “imitate compound biopesticides” and applied them to root systems of bamboo plants during late April to early June, 40-60 days after releasing predatory mites (*Amblyseius longispinosus* Evans). In IMP forests, pest mites were 1.4-1.6/leaf but in untreated forests there were as many as 160 per leaf. Yield was increased by 98-467% and the number of culm by 840-975 per acre after one year of integrated management. The diameter of the new culm in treated area was increased by 2.0-4.0cm and height by 2.0-4.2cm compared to untreated areas. We have established a sustainable forest and pest management model (Fig. 2).

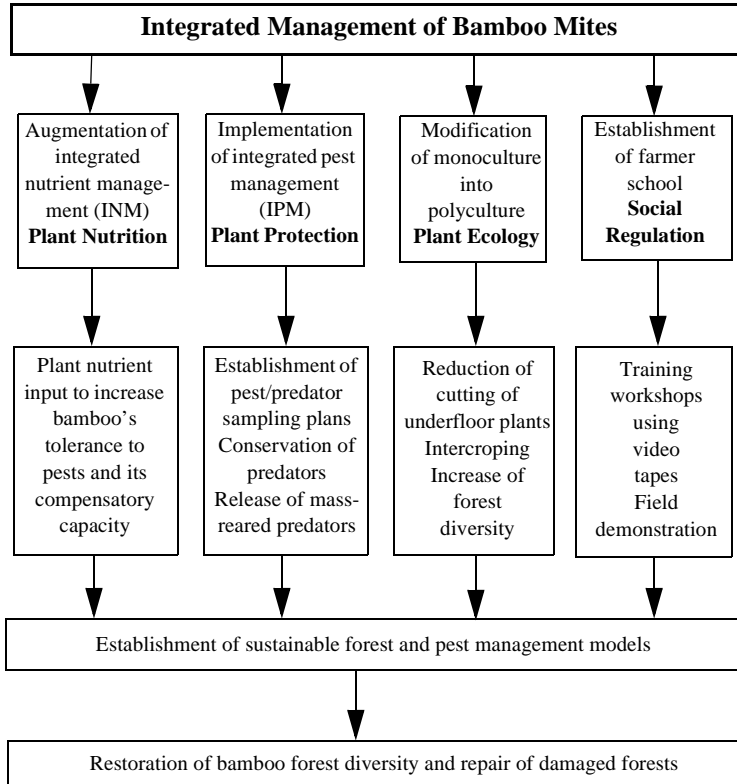


FIGURE 2. A schematic model of sustainable forest and pest management for the moso bamboo in Fujian.

Discussion

Changes in the cultivation of bamboo (monoculture, crowding of bamboo plants and removal of underfloor plants) may be major causes of mite outbreaks. Monoculture and removal of underfloor plants reduces alternative habitats/food for predatory mites which otherwise might

prevent spider mites from reaching damaging levels. Monoculture and crowding facilitate the dispersal of spider mites from plants to plants. These also deplete the nutrients in the soil and malnutrition plants thus become more susceptible to mites. Successful control of spider mites may therefore be achieved through modification of cultivation practice to restore the natural balance, which will in turn augment the natural enemies of phytophagous mites to keep them under control.

Pest mites (*S. nanjingensis*, *Ap. corpuzae* and *Ac. bambusae*) have caused economical, ecological and sociological problems in Fujian Province. Research on the systematics, biology and control of mites on the moso bamboo is progressing and some of the results are summarized in the following papers in this book.

Acknowledgments

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Abstract in Chinese

福建毛竹害螨发生, 发展, 为害及综合治理剖析

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摘要: 本文对福建省毛竹上南京裂爪螨, 竹缺爪螨和竹刺瘿螨的发生为害进行剖析, 讨论了害螨对毛竹生理和产量的影响, 探索了毛竹林害螨爆发成灾可能的原因, 提出了毛竹林害螨综合治理的图解模型。

关键词: 毛竹, 害螨, 爆发, 综合治理

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