Pests in tobacco storehouses and their control in China

Cheng Xingsheng, Wei chongsheng and Wang Fangxiao

Abstract
During storage tobacco leaves are often subject to many kinds of pests, thus suffer losses both in weights and quality. Investigations demonstrate that there exist as many as 79 pest species in Chinese tobacco leaf storehouses, these species belong to 7 orders and 31 families. Among them, tobacco moth (Ephestia elutella Hubner) and cigarette beetle (Lasioderma serricorne Fabricius) are the most widespread and harmful. Tenebrioides mauriianicus L., Attagenus piceus Olivier, Tribolium castaneum Herbst, Liposcelis bostrychophilus Badonnel sometimes also presents large quantity and causes certain damages.

Chemical treatments are the principal method in controlling the pests. The pyrethrins and DDVP are generally used to treat empty storehouses, or to kill the tobacco moth larvae crawling out from tobacco to be able to live through the Winter. Some factories utilize methyl bromide and phosphine for fumigation. In recent years, it has been possible to make use of methoprene due to the introduction of the threshing and redrying. Today, there are already three factories that adopt this pesticide that has proved to be a successful one. Another, semicon is introduced to predict cigarette beetle occurrence.

Introduction
China is an important tobacco producer with its yields of leaves and cigarettes ranking first in the world. Therefore tobacco industry exerts much influence on the economy of such a developing country. As well as at field growth stage, leaves during storage are also subject to various pests and consequently lose weight and usability. In this article we present the general situation about occurrence, damage and control of the pests in China.

Occurrence of Pests of Stored Tobacco Leaves
Pests discovered in tobacco leaf storehouses, as indicated in an investigation in 20 factories of nearly 10 provinces, include as many as 79 species, of which 73 belong to 28 families, 5 order of insects: 1 to a families, an order of Arachnida. Tobacco beetles and tobacco moths are most widespread and most harmful. Tenebrioides mauriianicus L., Attagenus piceus Olivier, Tribolium castaneum Herbst, and Liposcelis bostrychophilus Badonnel also occur in certain regions in relatively large numbers and cause certain losses.

Cigarette beetle (Lasioderma serricorne Fabricius)
A lot of studies demonstrated that 20 - 30°C and RH 70 - 80% are most suitable for the survival and reproduction of the species. Too high or too low a temperature or humidity inhibits its growth and development. China is broad and its climate varies markedly from south to north areas. South of the Yangtze River belongs to subtropical zone, where temperatures are much higher in winter and humidity keep higher all the year than in the northern part of China. In consequence, cigarette beetles occur seriously in the southern areas. For example, in Hefei, Anhui Province, the number of generations per year is 2 - 3; in Changsha, Hunan Province, 3 - 4; in Xiamen, Fujian Province, 4 - 5. By contrast, in areas north of the Yellow River, cigarette beetles can not survive through the Winter. Although the annual accumulated temperatures are enough for several generations, it is rare for them to occur in great quantities. Only in a few circumstances, e.g., when temperatures in spring or in summer are relatively high and adequate for tobacco beetles, pests carried on leaves transported from south will reproduce quickly and pose damages.

It was also found, according to the investigation, that cigarette beetles occurred more severely on the leaves that had been stored for 12 - 24 months. After 24 months of storage, as a result of overalcoholization and deterioration of some physical and chemical properties of the leaves, growth and development of cigarette beetles was instead inversely influenced and their population density decreased to some extent. For instance, the results of our studies in Hefei showed that for middle class leaves at one year, two years or
three to four years in storage, the population densities of cigarette beetles were 32.4 kg \(^{-1}\), 197.6 kg \(^{-1}\) and 980 kg \(^{-1}\) respectively. After being stored for 4 years actually no beetle was found on the leaves. Besides, sizes of populations vary with production regions or grades of leaves. On leaves produced in Yunnan, Guizhou and other areas south of the Yangtze River, on fair class and superior leaves, cigarette beetles occur severely.

**Tobacco moth (Ephesia elutella Hübner)**

Tobacco moth is another pest with large sizes of population. It is found all over the country. The number of generation is 3 in Hubei and Anhui, 3 - 4 in Guizhou, 2 in Henan. Temperatures and humidity influence much its development. Tobacco moth larvae show weaker cold-hardness than cigarette beetles and can not survive through the winter in northern part of China.

The occurrence of tobacco moth also bears relations to such factors as leaf grades, storing locations, storing periods, leaf moisture content etc. The adults have propensities in laying eggs, preferring fair class and superior leaves to inferior leaves. Population densities are higher on tobacco bales in the warehouses than on leaf stacks in the open. As to storage periods, the number of tobacco moths is the biggest at two years of storage. The higher moisture content of the leaves is, the more eggs there are on the leaves. In accordance with our survey in three tobacco factories in Anhui Province, the average population densities of tobacco moth larvae in the three factories are 3.24 kg \(^{-1}\), 3.82 kg \(^{-1}\) and 7.74 kg \(^{-1}\) respectively.

**Other pests**

In addition to the aforesaid two species, other common pests are *Tenebroides mauritianus* Linnaeus, *Tribrachidium castaneum* Herbst, *Attaphagus piceus* Olivier, *Liposcelis bostrychophilus* Badonnel. But their sizes of populations are generally small and their damage to tobacco leaves is relatively minor. For example, our inquiry into several tobacco factories in Anhui Province showed that red flour beetle and black grain beetle only accounted for 0.41% and 0.39% of the total pest number in the storehouses.

**Damage by Pests of Stored Tobacco**

Tobacco is a special kind of consumer goods. People smoking cigarettes wish a certain amount of nicotine to satisfy their physical requirements, and wash good taste and pleasant smell in the fume as well. Tobacco leaf is the principal material in manufacturing cigarettes. Making high-grade cigarettes need high quality leaves. Thus, damage by pests means not only leaf weight loss. What is worse, pests make cavities while feeding and reduce yield of cutting and leave behind a lot of feces and dead bodies which pollute leaves and spoil leaf taste.

**Leaf weight losses**

The Chinese General Tobacco Company has organized two nationwide surveys of the damage caused by stored tobacco pests. The results were as follows: (1) Leaves continually lost weight during storage (2) Weight loss was especially sharp within the first two years, and then slowed down. (3) The average weight loss percentages in the whole country were 1.58% for fair class leaves and 1.81% for superior leaves, at one year of storage. (4) Weight loss percentages may vary from area to area, since pests show taxis towards certain production districts (Table 1). It can be seen from Table 1, that leaves produced south of the Yangtze River had higher population densities and rates of damage. This can actually be explained by the differences in leaf qualities that leaves grown in areas south of Yangtze River are rich in chemical compositions and have large water capacity and thus can be served as flavoring tobacco, while leaves cultivated in northern part, which have high fiber content and can be mainly used as fillers to which pests show less taxis and slower population growth speed. (5) Storing locations also affect damage degree to the same class of leaves (Table 2). For the M - 3 leaves produced in Henan or Yunnan, having been stored for one year in some different places, the weight losses were the lowest in Shenyang, the highest in Xiamen, and displayed a tendency of aggravation of pest damage or weight loss from north to south.

Calculating on the basis of the total amount of stored leaves in the whole country, of the distribution of stored leaves, and of damage rate, China loses 32.8 million kg of leaf weight every year directly because of the pests, or 55.3352 million dollars, which is surprising.

**Influence on yields of cutting**

Since pests feeding on leaves provoke a lot of cavities on them, defect cut tobacco augment whereas yield of cutting reduce. The reduction degree of yield of cutting is positively correlated with pest population density. According to an investigation, the reduction rate averaged 2.5% in the areas south of Yangtze River and 1 - 1.5% in the northern regions.

**Table 1.** Pest population densities and leaf weight loss of fair class leaves of different production districts (1991).

<table>
<thead>
<tr>
<th></th>
<th>Heilongjiang</th>
<th>Shanxi</th>
<th>Henan</th>
<th>Hunan</th>
<th>Yunnan</th>
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<tbody>
<tr>
<td>density (kg (^{-1}))</td>
<td>5.8</td>
<td>21.4</td>
<td>29.4</td>
<td>157.6</td>
<td>139.0</td>
</tr>
<tr>
<td>weight loss (%)</td>
<td>1.14</td>
<td>1.53</td>
<td>1.47</td>
<td>1.84</td>
<td>2.19</td>
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</tbody>
</table>

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Table 2. Effects of storing locations on rate of damage by pests.

<table>
<thead>
<tr>
<th>density (kg⁻¹)</th>
<th>Henan M-3</th>
<th>Damage rate</th>
<th>Henan M-3</th>
<th>Damage rate</th>
<th>Yunnan M-3</th>
<th>Damage rate</th>
<th>Yunnan M-3</th>
<th>Damage rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xuzhou</td>
<td>22.3</td>
<td>1.73</td>
<td>45.0</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chongqing</td>
<td>26.0</td>
<td>1.15</td>
<td>438.8</td>
<td>2.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xiamen</td>
<td>38.2</td>
<td>2.27</td>
<td>68.6</td>
<td>4.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shenyang</td>
<td>0</td>
<td>0.25</td>
<td>0.5</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Causes of the severe occurrence of storehouse pests

In the light of some literatures, weight loss percentage in different parts of the world is around 1% on an average. In China the figure is more than 1.5%, because of: (1) Poor storing conditions and insufficient storing capacities of storehouses. For some historical reasons the Chinese tobacco factories are numerous but small. Therefore the factories allocate limited financial resources in introducing or importing advanced cigarette making equipment. The investments on storehouse construction are so few that storing conditions are poor and storing capacities are insufficient. Presently most factories south of Yangtze River store their leaves in the warehouses, lacking sealing conditions and other pest control facilities being bad. The bulk of factories north of Yangtze River store leaves in the open air. The result of the insufficient storing capacities, leaves of different period laid in the mixed way was that the pests cross infesting. (2) Packing material not up to pest control standards. In Chung, tobacco leaves are mostly packed with gunny bags, few being packed with plastic bags in combination with paper box packing. Compared with hogshead packing used abroad, our method shows no prophylactic effects to tobacco beetle and tobacco moth. Such being the case, it is very easy for pests to infest and reproduce. (3) Lack of strict examination of pest situation before allocation and transportation of leaves, which is favorable to pest diffusion. In making cigarettes, different tobacco leaves have to be blended. Factories must purchase certain kinds of leaves from different places of the country. Without strict examination of pest situation, pests may be brought in with leaves and spread. For instance, in the north-eastern region of China it is very cold in winter and pests in the storehouses can hardly live through the winter. But sometimes at the transition moment from spring to summer, pests do occur only because leaves introduced from south carried pest sources and then all the leaves in the storehouses got infested (4) Laying stress on elimination but taking prevention lightly. In controlling pests of storehouses, factories chiefly rely on chemical methods. However, limited by poor conditions and shortage of qualified technicians, only a small proportion of the factories could use fumigating techniques in the past, and the majoritively only sprayed DDVP, deltamethrin or other pyrethrins to exterminate surface insects without satisfactory results.

Current Control Strategies and the Future Development

In recent years, owing to the progress of China’s economic reform, the degree of growing in tobacco industry has augmented, and technologically there is a switch from artificial fermentation to natural alcoholution. As a result, the amount of stored leaves has increased. Meanwhile the rising prices of leaves enlarge the proportion of leaves in the total costs of cigarette finish products. Under such circumstances, the relevant factories pay more and more attention to pest control in storehouses. Measures taken are as follows:

1. Reinforce storehouse construction and normalize storehouse management. The Chinese tobacco industry administrative departments have set specific requirements and appropriate standards for storehouse construction. Now in the provinces south of Yangtze River there are practically no more open warehouses. In Hubei Province alone some 120, 000m² of standard storehouses were built from 1996 to 1997, and the storing capacity has been increased by 384 million kg, moreover, the newly built storehouses hold anti-pest gauze nets and can be sealed for fumigating. Regarding management, new and old leaves are now put away separately; examination of pest situation is mandatory before leaf transportation; definite speculations have been laid down in routine conservation of leaves.

2. Introduce newly tobacco infestation control method to ensure safe storing of leaves. Methoprene is a kind of insect parahormone (JH). Having fed on leaves treated with 10mg/kg methoprene, larvae of cigarette beetle or tobacco moth can not develop into normal pupae before dying. So far three Chinese factories have introduced the technique and it has proven to be successful. But since the chemical can only be used on threshing and redrying lines, its spread is much restricted. Yet China will set up about 100 threshing and redrying lines in its different parts after the year 2000. This movement, as we believe,
will promote a wider use of methoprene. As for how to use other chemicals, many factories take DDVP and deltamethrin to treat empty storehouses, or to kill tobacco moth larvae crawling out from tobacco bale to live through winter. Some factories choose methyl bromide and hydrogen phosphide to fumigate storehouses, in order to inhibit the development of storehouse pests, which is a success, too. Serricornae is also used to predicate the outbreak of cigarette beetle by some factories.

It deserves to be mentioned that some Chinese factories, while treating cured leaves, seal them with plastic covers and put in oxygen-scavenging chemicals. Cured leaves, of which water content is 18% or so, are easy to go mouldy and to get infested by pests. This can be avoided before redrying by the above-mentioned method.

Since tobacco industry carries weight on the Chinese economy, the Chinese government attaches importance to its progress, e.g., found special scientific research institutions and schools; create the specialty of tobacco storing, in the hope of enabling students to grasp knowledge of routine management of storehouses, to master tobacco leaf production conservation and pest control techniques. Training of this type of specialists will greatly change the present situation of storehouse technician shortage and will certainly facilitate the control of tobacco storehouse pests.

References


