

Current and future direction of stored product protection in Thailand

Salakpetch, S.*, Kongchuensin, M.#, Somboonkaew, N.
Department of Agriculture, Bangkok 10900 Thailand.

*Corresponding author, Email: surmsuk.s@doa.in.th

#Presenting author, Email: manitathai@yahoo.com

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Abstract

Although Thailand is one of the largest producers, processors and exporters of agricultural commodities and their products including food and biofuels, the number of imported commodities is increasing. Import and export of stored products without sufficient regulations and controls leads to transboundary pest and disease movement, especially between countries who share a land border *viz.* the Association of Southeast Asian Nations or ASEAN. Establishment and application of regulations among ASEAN must be concerned for quality and safety of commodities with less transboundary movement of pests and diseases. Thailand aims to apply “safe to users – danger to pests” methods to protect stored products. Safe use of chemical is still a useful technique but alternative controls e.g. application of essential oils and antagonists have been developed to control pests and fungi in stored crops, particularly in small scale farms. Larger scale and industry will investment more in storage structures, containers, stacking management, control of storage environments and computerizing operation. Traditional storage will be gradually replaced by modern warehouses. These important steps for protecting stored products in Thailand and ASEAN not only reduces postharvest losses and maintain quality of durable crops but also enhances worldwide food security as a source of world food suppliers.

Keywords: stored product, Thailand, food security, food safety, alternatives to methy bromide

1. Introduction

About 114.6 million rai, or 45.8 million acres is used for agriculture in Thailand (The Agricultural Census, 2013). Agricultural products in Thailand are produced for local consumption and for exports. Agricultural production and the agro-industry in Thailand have been expanded and now Thailand ranks 15th in the world for production and export of food products (FAOSTAT, 2014). Major exports are rice, cassava and corn (Table 1). In 2014, the export value of agricultural commodity and product accounted for 40,188 million \$US (Office of Agricultural Economics, 2015). Main destination markets are Asia, ASEAN, the Americas and the EU, in order.

Table 1 Thailand major exporting stored products in year 2014.

Stored products	Quantity (ton)	Value (million US dollar)
Rice	10,969,335	5,369
Cassava	6,800,151	1,505
Corn	631,497	158

Source: Office of Agricultural Economics, 2015

However, Thailand still imports products, in particular soybean, cake of soybean, wheat and coffee bean to support a high demand of agro-industry (Table 2). These imported commodities require proper storage, transportation and handling. Inappropriate storage management could result to unmarketable quality of stored products, since it is important to develop and apply the technology to maintain a high quality of stored products free from insect pests, fungi and mycotoxin contamination.

Table 2 Importing stored products to Thailand in 2014.

Stored products	Quantity (ton)	Value (million US dollar)
Soybean and cake of soybean	4,787,517	2,745
Wheat	1,557,519	474
Coffee and Cocoa bean	63,844	152

Source: Office of Agricultural Economics, 2015

This overview of stored product protection in Thailand will be discussed by starting with recent situation while the future plan will be discussed and summarized.

2. Current situation of stored product protection in Thailand

As mentioned above, agricultural products of Thailand is not only supplied for local markets but also exported to worldwide destinations. The average market share of agricultural commodities from Thailand to ASEAN and the World between 1984 and 2012 was approx. 27.73 and 2.20%, respectively. Thailand imported agricultural commodities from ASEAN about 16.83% while 0.73% of commodities was supplied from outside the ASEAN region (Table 3). These statistical data could imply that number of stored products in Thailand for export and from import may increase in the future.

Table 3 Proportion of export and import values of Thailand agricultural products to ASEAN and World during 1984-2012.

	1984-1989	1990-1999	2000-2009	2010-2012	Average
Export					
Thailand/ASEAN	26.35%	29.70%	28.41%	26.44%	27.73%
Thailand/World	1.69%	2.19%	2.24%	2.67%	2.20%
Import					
Thailand/ASEAN	15.07%	19.98%	15.56%	16.72%	16.83%
Thailand/World	0.42%	0.80%	0.78%	0.91%	0.73%

Source: WTO Statistics Database, 2014

2.1. Crop production practices in Thailand

How does Thailand deal with a huge amount of products from local farms, from importer, and for domestic and worldwide distribution? It is important to focus on the appropriate place to store these products, which can maintain postharvest quality and prolong postharvest life of the commodities. Rice, corn and cassava are three major crops grown across Thailand. The production, processing and storage of these crops can be divided into three levels *viz.* small, medium and large scales.

2.1.1. Small scale practice

Crops are commonly harvested by hand but small machines are used as well. Harvested crops are sun-dried for at least 2-3 days. The drier the product the greater price. Dried products are then stored in a small barn and transported to village mill for processing. Otherwise, they will be sold to a collector and distributed to larger scale processor. Chemicals e.g. fumigants are not used for postharvest handling at the small scale farms. Products from small farm are a food source for consumers.

2.1.2. Medium scale practice

For the medium scale practice, machines e.g. combine harvester is usually used for harvesting. Crops will be sun-dried to reduce moisture, milled, packed and stored in a warehouse. Stored products from this stakeholder are distributed to nationwide markets or to the export company.

2.1.3. Large scale practice

Large to extra large scale production has a tendency to invest in computerized operation with high performance machines, particularly in processing and storage management. For instance, cool dry air is supplied through pipes connected to the stored paddy. The temperature and humidity in the grain mass remains stable at levels which can control insect pests and disease occurrence, resulting in premium quality of rice. Demand for Thai premium rice in worldwide markets is increasing dramatically. Several mills and warehouses have been renovated to use computerized machines instead of labour, leading to higher productivity.

2.2. Current awareness

2.2.1. Food safety and security

From past to present, Thailand has emphasized food safety, from production through the supply chain, which aimed to reduce insect pests and diseases, decrease pesticide and fungicide residues, and prevent mycotoxin contamination. However, food security recently becomes a key issue for an agricultural development strategy for Thailand. It is due mainly to decrease of agricultural areas and workers, which could lead to lower productivity, while postharvest losses caused by insect pests and diseases continuously occur.

2.2.2. Expansion of trade

Another concern is an expansion of trade area especially among the ASEAN community and new free trade areas. Import and export of agricultural products may cause transboundary insect pest and disease movement. Invasive pests are a concern in Thailand and may affect product quality, quantity and security. For instance, Khapra beetle (*Trogoderma granarium* Everts), a priority invasive insect pest of various stored products. The introduction and spread of Khapra beetle would greatly affect the stored product industry, especially rice and corn. If invasion and establishment occurs, Thailand would confront various difficulties for exporting rice to different destinations. The cost to eradicate this pest would be extensive and would have negative impacts on export trade.

2.2.3. Loss of methyl bromide

Methyl bromide is a chemical used to fumigate soil before planting and for postharvest treatment and structural fumigation. It is extremely effective but is also recognized as an ozone-depleting substance. Import of methyl bromide to Thailand decreased between 2008 and 2013 (Figure 1). This is due the phased out under the Montreal Protocol. In Thailand, this fumigant will be banned in 2015 except for use in Quarantine and Pre-shipment (QPS).

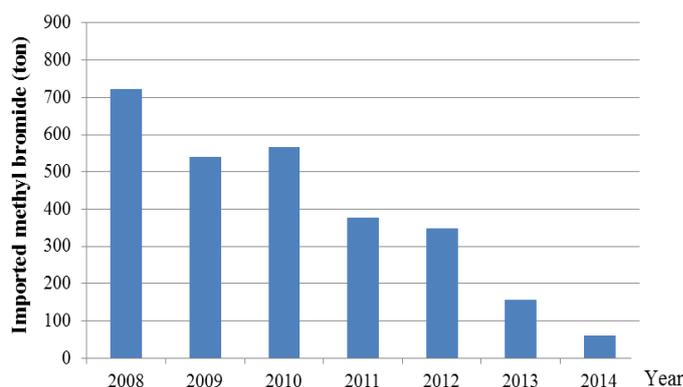


Figure 1 Reduction of imported methyl bromide to Thailand between 2008 and 2014 (source: Department of Agriculture, 2015)

2.2.4. Recent alternatives to methyl bromide

The alternatives to methyl bromide are being developed. The Department of Agriculture promotes voluntary use of phosphine as an alternative to methyl bromide for fumigation of stored grains. Although, aluminum phosphine is a common fumigant used for rice mill and warehouse in Thailand, the users are not satisfied with its efficiency and cost.

Another alternative fumigant is carbon dioxide (CO₂). This fumigant has been available for decades but not normally used due to complicated application procedures and costs. However, CO₂ is suitable for organic products and is widely used for organic rice mill fumigation. Another fumigant is ECO₂ FUME, which is a ready-to-use, non-flammable mixture of phosphine and carbon dioxide that enables highly effective fumigation for a wide variety of sealed-storage applications. It is dispensed external to storage or structures using simple techniques which avoid applicator exposure, eliminate confined space entry, and enhance overall worker safety. The Department of Agriculture recently established a proper application rate of ECO₂ FUME for stored products and pest fumigation in Thailand. ECO₂ FUME could be an alternative to methyl bromide in Thailand in the near future.

3. Future direction of stored product protection in Thailand

Research and development of stored product protection must be emphasized more in Thailand. The research and development include alternative fumigants and insecticides and their application, use of biological agents to control stored pest and fungi, and application of controlled atmosphere treatment system (CATS). The research and development strategy must concern the workers safety.

3.1. Strategies for food safety and food security

Apart from research and development, Thailand will establish and revise legislation, regulations, standards, guidelines and measures to enhance food safety and meet trade requirements. Plant Quarantine Stations across the country will be improved to facilitate trade, conduct research on science-based measures to protect plant life and plant health, and to improve service efficiency. From 2015, the tariff of various stored products *viz.* rice, corn, soybean, oil palm and coffee bean among ASEAN will be dramatically decreased (Thai-AEC, 2012). The amount of imported products in Thailand will largely increase and may result in introduction of invasive species. The spread of transboundary pests poses risks to various

crops in Thailand. Thus, sampling practices at port for both exported and imported products must be increased and improved. The inspectors have to follow guidance to National Plant Protection Organizations (NPPOs) in selecting appropriate sampling methodologies for inspection or testing of consignments to verify compliance with phytosanitary requirements (ISPM no. 31). Diagnostic capability for correct detection and analyses of insect pest, disease and mycotoxin contaminations must be improved. Apart from ASEAN community, the cooperative between Thailand and ASEAN, ASEAN+3 (China, Japan, India), ASEAN+6 (China, Japan, South Korea, India, Australia and New Zealand) and other free trade area will be developed to meet the trade partner's requirement and regulations.

3.2. Development of alternatives to methyl bromide

3.2.1. Biological control

Thailand is rich in biodiversity. Various plants have been reported as antagonists of pest, fungi and other organisms. In Thailand, there are many projects studying the effects of plant extracts on pests, fungi and mycotoxins in stored products. For example, essential oil extracted from Litsea plant (*Litsea cubeba* (Lour.) Persoon) could control cigarette beetle (*Lasioderma serricornis*) and drug store beetle (*Stegobium paniceum*) adults. Garlic juice successfully controlled growth of *Aspergillus* spp. fungi and amount of aflatoxin in stored dry chili (Chinaphuti, 2012). Garlic juice contains high levels of allicin which is an effective anti-fungi agent. Fresh chilis were soaked in the diluted garlic juice before drying and packed in plastic bags for 2 months. Reduction of aflatoxin increased with a high concentration of garlic juice. This technique will be applied for a small dry chilli factory in the near future for a commercial scale trial. Application of assorted local medical plant extracts are also being developed for controlling pest and microorganism in agricultural commodities and products.

3.2.2. Controlled atmosphere treatment system (CATS)

Controlled atmosphere treatment system (CATS) is an environmentally friendly postharvest mitigation treatment that uses low oxygen and high carbon dioxide atmosphere combined with controlled temperature and relative humidity to control quarantine pests. CATS can be used as a quarantine treatment against insect pests of various commodities *viz.* grain, seeds, corn, nuts, beans, dried fruits, tobacco, coffee, tea, cocoa, spices and herbs. However, dose required killing the target insect pests in Thailand and operating costs are being determined.

4. Conclusions

Thailand considers food safety and food security to be important. Therefore, future direction of research and practices for stored product protection in Thailand will not only reduce postharvest loss, maintain quality, prolong postharvest life but also enhance of product safety, green environment and worker safety and welfare. These practices will help secure food and energy sources for Thailand and the world.

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