MANAGEMENT OF RED INVASIVE FIRE ANTS AND FRUIT FLIES-THE TAIWAN EXPERIENCE

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ABSTRACT

Red imported fire ant (Solenopsis invicta) *or RIFA, was first reported in Taiwan in September 2004. The infested area was around 46,000 ha and mainly located in Taipei, Taoyuan and Chiayi counties. To address this problem, the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) under the Council of Agriculture (COA) quickly set up the standard operation procedures for surveillance, monitoring and control measures and established the National Red Imported Fire Ant Control Center (NRIFACC) for related technical support. Several working groups were formed in coordination with different governmental authorities and local governments to fight against RIFA. Currently, the fire ant control efficacy is around 88% in Taipei and Taoyuan counties and 94% in Chiayi. Oriental fruit fly* [Bactrocera dorsalis *(Hendel)*] *was introduced in Taiwan in 1911. It is currently well established in Taiwan. In severe years the damage reached to 90% of the fruit production and the economic loss due to pest was estimated at USD 400 million island wide. The cost of quarantine treatment for fruit exportation due to this pest is around USD 5 million annually. A lure by mixing methyl eugenol and naled is the major tool for suppressing male population in large scale. The control area covers 120,000 ha of fruit plantation mainly located in central and southern part of Taiwan where most of the tropical fruits are produced. The average fly density was kept at about 70 male/trap/10 days and the estimated loss is less than 5% of the total fruit production annually. In areas with higher fruit value, spinosad application is encouraged to suppress female population as part of IPM strategy.*

Key words: Red Imported Fire Ant, RIFA, oriental fruit fly, area-wide control, Taiwan

INTRODUCTION

With the expansion of global trade and international travel, the chance of introducing new pests is increasing. New introduced pests could have a devastating impact on local ecosystem, economy and trade. Preventing the spread of emerging pests heavily relies on good safeguarding practices and international cooperation. The following two cases describe the Taiwanese experience in managing invasive pests.

MANAGEMENT OF THE RED INVASIVE FIRE ANTS

Brief History of Red Invasive Fire Ants

RIFA is native to South America but it is known in the United States since the 1930s. Today they are found in many parts of southeastern United States. In the turn of this century, they were found to invade New Zealand and Australia in 2001. Subsequently in 2003, the presence of RIFA was confirmed in Taiwan and later in Quangdong, China. Then, RIFA was found in northern Hongkong, Macau, and the Philippines in 2005.

In Taiwan, the first two suspicious ant sting cases were reported in Chiayi and Taoyuan areas in September 2004. Later RIFA invasion was confirmed. The following survey found that infestation area reaches around 46,000 ha and mainly located in Taipei, Taoyuan and Chiayi counties. The RIFA invasion created a serious public scare throughout the island.

Action Plan and Intergovernmental Cooperation

The Council of Agriculture (COA) declared RIFA as a quarantine pest in September 2004 and strengthened the border quarantine measures. All imported products including cargo from the infested areas were subjected to RIFA check. If contaminated with fire ant, the import will be quarantined or reshipped.

Domestically, the infestation areas were mapped in cooperation between and among entomologists from universities, research institutes and eight local district agriculture improvement stations. The infested areas and buffer zones were carefully identified and localized by using geographic information system (GIS). The risk of the pathway for RIFA to spread out was also identified. The aim is to prevent RIFA from spreading, to control it effectively and to secure public safety.

Since potted plants were identified as the major source for RIFA outspread, COA enacted 'the movement control operation procedure for the control of fire ant among floriculture operators' in December 2004. A task team for nursery examination was formed through the joint efforts of the central and local government. An immediate pesticide treatment was conducted for RIFA-contaminated nursery. BAPHIQ restricted the movement of infested soil, seedlings, nursery stock, turf, planting materials and containers to other locations. Those who attempted to violate paid fines based on the Plant Protection and Quarantine Act.

Many private and public buyers demand growers to submit the RIFA-free certification during the trading process. For example, city government of Taipei, the largest customer of potted plants, recognized certification as a must for commercial pot plant providers.

BAPHIQ also worked out several standard operation procedures for surveillance, monitoring and control measures, and established the NRIFACC in 2003-2004. The main role of the NRIFACC is to develop control strategies and to provide technical support.

The "RIFA update" panel was formed under the Vice-Minister of COA. It was composed of members from the Environment Protection Administration (EPA), the Department of Health (DH), the Ministry of Education (ME), the Ministry of Interior (MI), the Ministry of Economic Affairs (MEA), the Ministry of Transportation and Communication (MTC), and the Taipei, Taoyuan and Chiayi local governments. Each of them had its own budget and eradication program for RIFA, and the panel meeting was held every half a year or so in order to follow up the progress of national eradication program.

Control Programs, Measures and Achievements

Before 2004, an emergency control program was forwarded to stop the spread of the RIFA infestation. During that period, identifying the infested area and measuring the infested acreage were prioritized. After 2004, the policy goal was to minimize the impact down to a tolerable level.

A couple of ant-killing methods were recommended for RIFA control. In household or high-risk areas such as kindergarten or elementary schools, bug sprays were recommended to reduce the risk of human exposure. For individual mound, shoveling the mound and immersing it into detergent water was recommended. In principle, the pesticides are the major tools in controling RIFA in Taiwan. However, the type of pesticides and usage of chemicals were carefully chosen to lower the environmental impact.

Two types of control approaches were categorized and these are individual mound treatment (IMT) and area-wide treatment (AT). For IMT, depending on the size of the mound, contact insecticides with moderate toxicity such as fipronil, chloropyrifos, carbaryl and some pyrithroids were used to eradicate the ants immediately. After the treatment, an

intensive follow up was required to ensure successful eradication. As for low-tolerance areas such as schools and parks, where people are exposed to fire ant sting, the individual mound treatment used one or two times of bait treatments immediately to reduce the risk.

In area-wide control, five kinds of baits have been chosen in Taiwan. They are 0.5% pyriproxyfen, 0.015% spinosad, 0.00015% fipronil, 0.045% indoxacarb and 0.5% s-methoprene.

For effective and precise control, bait broadcaster was mounded on beach vehicles to cover larger areas in a short time. Geographic mapping techniques were applied to ensure sufficient precipitation of the bait in each unit area.

Seminars and training courses regarding RIFA were often held. Participants were taught to be aware of the seriousness of RIFA in local agriculture, ecology, economy, and people's safety. They were also taught the techniques to control and monitor the RIFA on their own. Most importantly, the public was educated through various media to report immediately any occurrences of new RIFA infestation, so that eradication measures can be done as early as possible.

To spread the information on fire ant and to raise public awareness, NRIFACC conducted workshops for government organizations, civil associations, different levels of school, and private enterprises. Information concerning ecology, damage, identification, control methods and medical attention of fire ant were addressed during the workshops. NRIFACC also demonstrated the techniques to control fire ant on site, enabling the training participants to treat fire ants appropriately. Meanwhile, NRIFACC has designed various materials including handbooks, models, specimen, bookmarkers, CDs, T-shirts and hats for free to educate the public.

Recently, control efficacy surveys conducted by NRIFACC and the Taiwan Agrochemical and Toxic Substances Research Institute showed that Taipei and Taoyuan has 88% or so control efficacy while Chiayi has reached 94% control efficacy.

MANAGEMENT OF ORIENTAL FRUIT FLIES

Brief History of the Oriental Fruit Flies

Oriental fruit fly was first reported in Taiwan in 1911. In 1956, the government conducted the first male annihilation program by using methyl eugenol mixed with dichlorvos and protein hydrolysate mixed with malathion as baits to control fruit flies. By learning successful eradication case in Okinawa from Japanese counterparts, a sterile insect technique (SIT) was introduced between 1975 and 1985. Once the steriled fly number for weekly release reached up to 30 million flies, however, the results from the fields were not consistent. Part of poor results was attributed to insufficient flood ratio. Part of failure was attributed to the public's poor impression and their disbelief that this method could eradicate oriental fruit fly in Taiwan.

After 1985, male annihilation by using methyl eugenol mixed with 5% naled was used as standard tool for area-wide control because it costs less and is more convenient. The annual cost for male annihilation is about USD 10/ha. It is also easy to apply in the field. To increase the coverage area and control efficacy, a trebuchet was once developed to throw baits over a wide range of fruiting evergreen plantations as an attempt to broaden the bait coverage. Between 1994 and 1999, airplane was even used to broadcast baits. However, this method was discontinued due to high cost and the absence of solid evidence to show its control efficacy. In 2000, the area-wide control program covered 12,000 ha of fruit plantation in Taiwan.

Control Programs, Measures and Achievements

Currently, the oriental fruit fly program consists of two elements: 'fly watch' and bait delivery. Fly watch is a monitoring program mainly organized by scientists from the Taiwan Agricultural Research Institute (TARI). They identified 77 townships as high-risk area and set up 613 monitoring sites for collecting population data in 10 days interval. These monitoring sites covered not only orchards but also natural plantation. In 2008,

all monitoring sites were positioned using global positioning system (GPS) to collect enough temporal and spatial information. The information was quickly published through the Internet and in paper and disseminated to communities and farmers' associations.

Bait delivery was conducted through a contract between BAPHIQ and manufacturers. The amount of bait delivered to each local government was through a panel review to evaluate the need and potential risk of each fruit crop and location. Generally, the bait was delivered to the growers four times a year. But in high-risk areas, the delivery could increase up to six times.

In addition to TARI, other research organizations such as the Taiwan Agricultural Chemical and Toxic Substances Research Institute (TACTRI) and eight district agriculture improvement stations collectively contribute to the fly watch program and to the development of new techniques for fruit fly control. In some areas where fruit price are high, spinosad lure was applied as additional measure to control female population.

The area-wide control program of fruit fly involved about 200 personnel. Through the cooperation from all participants, BAPHIQ was able to maintain the annual density at about 70 male/trap per 10 days between the years 2000 and 2007, with an estimated loss of less than 5% of the total fruit production annually.

CONCLUSION

The fight against emerging pests requires global collaboration and multi-disciplinary effort. Neighboring countries should ensure that their national regulatory agencies are closely involved in national strategic decision making processes and are engaged as key stakeholders in multinational planning. International organizations such as FFTC should lead the regional preparedness for pest prevention and promote practices such as transparency of epidemiological information, and coordination of information and technology transfer.

It is important for national regulatory agencies to establish a mechanism to share epidemiological data and not allow the emerging threat to compromise the produce.

Fortunately, the war against RIFA has reached a satisfactory state in Taiwan. The control efficacy of RIFA reaches over 90%, suggesting that we have significant progress. However, as the eradication program progresses, new challenges are increasing. For example, relatively humid weather has reduced the efficacy of the baits. More intensive labor is needed for detailed surveillance especially when the infestation area is getting inconspicuous. Lack of consensus among nursery growers makes movement control inefficient, and so on. More basic studies concerning the behavior, habitat preference, population ecology and mode of dispersal are needed.

Although it is not difficult to gather information and related knowledge through the Internet, Taiwan still welcomes information exchange throughout the region. In the war against RIFA and oriental fruit fly, Taiwan is a unique case in terms of terrain complexity, ever changing climate and control strategy, which provides scientists a very unique experience and this experience, certainly can provide nearby countries some insights regarding control programs of these two pests.

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