INSECT PEST MANAGEMENT FOR PITAYA IN TAIWAN

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ABSTRACT

Pitaya or dragon fruit (Hylocereus spp.) is an emerging fruit tree that has been popularized and cultivated in recent years in Taiwan. Due to the improvement and promotion of planting techniques, the cultivated area has almost reached 2,500 hectares across the country until 2017. With the full cooperation between researchers and farmers, the quality and flavor, as well as the people's consumption have all gradually increased. Under the export demand for domestic dragon fruit, pests issue will become important. In Taiwan, pest occurrences in dragon fruit can be classified into two categories according to the crop growth period. Some pests occur during the plant growth and flowering stages, such as moths, thrips, aphids, and beetle pests, and others occur during the fruit stage, such as fruit flies, mealybugs, stink bugs, beetles and snails. Most of them have a direct or indirect relationship with ants. Therefore, for the pests, it is imperative to control the ants and develop effective management strategy. The low-toxic or non-pesticide materials are recommended to control ants for the organization of the growers, practice the area-wide integrated pest management (AW-IPM), and suppress population densities for the fruit flies in the future.

Keywords: moths, thrips, milkbugs, fruit flies, AW-IPM

INTRODUCTION

The pitaya (or dragon fruit) (Hylocereus spp. and Selenicereus spp.) is a new tropical fruit tree popularized in Taiwan. With the cultivated area that has already been up to more than 2,500 hectares, it is increasing gradually year by year. But there is still lack of information on pests and the control technology of this fruit tree pest in Taiwan. This research assists to guide in the diagnosis and control of pests in the production area of the pitaya fruit. It also includes a survey of insect pest on pitaya's orchard including the whole Taiwan. The major constraints in dragon fruit production are attributed to biotic and abiotic factors. In this paper, we focus on the biotic factors to discuss the pest impact on the pitaya fruit.

Compared to other fruit trees, the pests of pitaya are less and easier to control and manage in Taiwan. It is a high-value crop that has lured many farmers to increase its production. However, after enjoying four years of good production, the crop manifested susceptibility was attacked by insect and diseases. It is lack of information to understanding them. The researchers surveyed the whole cultivated area, and found some emerging pests, such as insects, snails, birds and rodents, which caused production and economic losses for the growers. The paper is to confirm the insect pests in pitaya, so far, there are 43 species of pests confirmed. It described the common pest species and habits of dragon fruit orchard, the methods of prevention and control, and provide the managing guidelines for farmers. In Taiwan, pest occurrences on dragon fruit can be classified into two categories according to the crop growth period. Some pests occur during the plant growth stages, such as moths, thrips, aphids, and scales, and others occur during the fruit stage, such as fruit flies, mealybugs, stink bugs, beetles and snails. But the ants attack at any growth stage of the dragon fruit. And so far, mites have been seldom found. Let us describe the pest how to attack damage dragon fruit as follow.

Plant growth stage: it is the date from January to April. Most of pests attack the stem bud or stem for the pitaya.

A. Moths: The study investigated nine species of endangered during the planting stage of dragon fruit. They include Porthesia taiwana, Hemerophila atrileneata, Spodoptera litura, Helicoverpa armigera, Trichoplusia ni, Amsacta lactinea, Olepa schleini, Orgyia postica, Ostrinia spp. and so on. The larvae gather to nibble on young shoots, or to nibble along the edge of the plant that cause the plant to break and have a delayed growth. In the prevention and control methods, we have developed sex pheromone only Spodoptera litura and Helicoverpa armigera for the prevention and utilization. The baits were used as control and monitoring materials on Taiwan’s
organic farms. Other moths are controlled by light traps during the night to attract the adult moths. Only chemical agents can be used to control larvae, but many chemicals were not yet registered in the application of moths for dragon fruit.

B. Ants: They have become a key pest in cultivated pitaya in the recent year. They attacked the pitaya at any stage of the crop’s growth, depending on the specific species. Some species will directly damage the growth, shoot, bud or fruit, resulting in plant growth delayed or injury. Such as tropical fire (Solenopsis geminate) attacked serious damage on the young shoot. But other species will assist some scales (mealybugs) or aphids dispersal into the fruit. In act Some of ants can impact on cause serious damage, but the low density of ants on growth are beneficial, because, the stage secretes honey dew during the dragon fruit growing stag, so ants remove it to reduce the occurrence of sooty mold. Due to the inherent physical characteristics of pitaya, buds and young fruits secrete honey dew, need some ant feeding the honey dew to avoid sooty mold. The investigation was found fourteen species to attack on the pitayaso far, pike ant (Polyrachis dives), (Camponotus light), Chinese ant colony (Monomorium chinense), Flower-home ant colony (Monomorium floricola), (Monomorium intrudens), Japanese wrinkle ant (Tetramorium nipponense), the tail home ant (Crematogaster nawai), (Pheidologeton diversus), (Pristomyrmex punctatus), (Tapinoma melanocephalum) and (Technomyrmex brunniceps), and so on. In general, controlling ants, commonly used bait to suppress the colony, but so far the bait is not yet finished in registration and used in limited area and currently only was approved on agricultural land to control red imported fire ants (RIFA, Solenopsis invicta). It is urgent work to develop new materials in Agriculture land use to other ants.

C. Thrips (Franklioniella intonsa) located in the bud or on the surface of the fruit. The low density of thrips in the bud causes flower damage but can sometimes help in flower pollination. Small thrips in the bud can cause fruit damage at the early stage in the flower and near the fruit stalk resulting in the appearance of fruit brown rough scar or small cracks, but this has little impact in the the fruit. If the thrips density is high, it is recommended to pave the mattress or reflective plastic sheeting, reduce the chance of the thrips into the soil to change pupa, and reduce the weeds for shelter. Setting the yellow sticky paper (can also trap aphids and fruit, melon fly and other pests), may also reduce the occurrence of thrips.

D. Scales attacks the surface of the stem or branches. There are black webs and looks dirty. Generally the scales stayed at the branch that is not direct exposed to sunshine. So the branches look dull. These pests can be controlled by spraying liquid soap with dose of water once a week on a branch that was attacked.

E. Cotton aphid (Aphis gossypii) likes dry, warm climates, through parthenogenesis, aphids have the ability to develop rapidly in optimum temperature. They often gather in the stems, buds and fruit. In addition to the direct damage caused on the plant growth delay, and the secreted the honey dew, which cause sooty mold. Sometimes they gather in the tender shoot thorn suction stems, or in the bud. In addition to causing the honey dew to accumulate large amounts of fruit when the growth is impaired, the fruiting of the bud is poor. When they high densities, soot disease can occur. The control agent can be used in the garden to catch winged aphids with yellow tray or yellow sticky paper. Other predators such as ladybugs or lacewing larvae can also be exploited.

F. Mites (Tetranychus sp.) will attack the bark or branches that damage tissue and infest the shell. They attack plants by sucking the liquid on the trunk or branches causing the branch to turn yellow. To control the mites one can also use the same treatment as scales. But the mites damage on the dragon fruit occurs less frequent in Taiwan.

Fruit stage: It is the date from June middle to December. Most of them attack the fruit stage or little bit flower.

A. Fruit flies: Oriental fruit fly (Bactrocera dorsalis) and melon fly (Zedugodacus cucurbitae) were commonly known as an important horticulture and quarantine pest. The main damage on the fruiting period, in general happens through theattraction of female ovipositing, and laying of eggs in the skin of fruit, eggs hatched the larvae latent food pulp, resulting in fruit decay or premature drop, which affect the quality of the fruit. Because these fruit flies attract many kinds of fruit variety, the area-wide integrated pest management should be implemented to reduce population and economic loss. In orchards, bagging can prevent fruit flies damage, however, hanging methyl eugenol traps could be used in the long term. In The implementation of spot-spraying pesticide hydrolysis protein food bait could also be strengthened. The purpose is to decrease the damage caused by fruit flies. Of course, field sanitation is very important concept to avoid breeding of fruit flies. Suppressing the oriental fruit fly, usually takes toxic methyl eugenol and food bait. There are safe materials, such as food bait, poisonous protein hydrolysate that lure agent, and can effectively control the fruit flies on the dragon fruit under tolerable density (economic threshold). Melon flies flown into the orchard spawning bud at the flowering stage, resulting in damage to the flowers, and affect the subsequent planting growth. Generally it will not invade the
ovary and produce offsprings on the flower. The impact is limited, with less damage to the mature fruit. The control method is similar to the oriental fruit flies but the attractant as cuelure to kill males, supplemented with pesticide-containing yeast food bait to attract adults.

B. Mealybugs (*Planococcus Mino*), damage many kinds of host plants are widespread in the field, and are common in the tender stems and fruit stage. They are frequently carried by the ants into the dragon fruit. If the mealybugs are not detected early fruit quality might be affected the growth stage. The harmful effects of a wide range of (*Phenacoccus solenopsis*) are also found on the tender stems. At present, such pesticides have a broad effect for dragon fruit and pesticide residues in the future. The study focus on how to teach farmers the proper way of pesticide application during the harvesting period. In addition, when the density of mealybugs is low, liquid soaps and soybean oil emulsions which are developed by TARI (Taiwan Agricultural Research Institute) could be used as safe materials to prevent the mealybugs. In addition to the scale (*Diaspis echinocacti*) crisis damage occasionally can be found on the older tree, it is recommended to chop down the burned part of the plant.

C. Beetles: The oriental white flower beetle (*Protactia orientalis*) was mainly found on the dragon fruit, with the adults having coarse mouth, chewing stem which are often caused by the wound. Their juice attract a large number of ants, so that the enlarged wound can cause the disease or winds break down the plants. In general, it is difficult to use the chemical control, but it was engaged in using light trap by phototaxis for the adult (5-8 months). Black lamp was installed at the orchard for four weeks and a water basin containing soapy water was placed under the lamp to attract it. Beetle larvae grow in soft damp and moist soil, compost, organic matter soil, can be used as pesticide remove larvae or tillage exposure and reduce the occurrence of beetles. Also we found coffee long horn weevil (*Araecerus fasciculatus*) on the fruit during the flowering period and ripening stage, but the population is low and has not yet caused economic loss now, may use bagging to protect the fruit.

D. Bugs or stink bugs: In our investigation, south green bugs (*Nezara viridula*) and angular shoulder bugs (*Rynchocoris humeralis*) were found during the rice harvesting season. They have common infested characters showing the mouth entering the bud to suck the sap, or entering the bags to suck the fruit juice during the fruit stage. This is the reason what they sometimes induced the disease. During the summer season, the population density is high, and the bugs are very active and not easy to catch them. Both adults and nymphs stage will sting the harmful fruit. So far, many kinds of sting bugs have not yet been recommended to treat in chemical or efficient materials on the dragon fruit, but the eggs can be controlled by egg parasites, or in the park by hand to clear the egg heap.

E. Snail, Slug and other pests: Although they are not considered insects, they are also known as pests that harm the dragon fruit during the ripened fruit stage. The snails or slugs like to crawl into the skin of fruits, stripes appear on the skin, which often cause the fruit to rot, and also affect the fruit quality. It an important factor to cause the production loss of dragon fruit in Taiwan. The bitter tea meal can also be used as a control material, but it is still subject to the official approval for the lethal effect on aquatic life. Farmers frequently use diatomaceous to obstruct avoiding snails crawling to the fruit.

F. Birds have also been one of most annoying hazards for growers, but most of them take the bagging and anti-bird-feeding nets in the ripening stage. The direct attack has been gradually reduced, and some farmers use sonic or long bamboo poles, which can also reduce the risk of bird feeding.

**INTEGRATED PEST MANAGEMENT**

Integrated pest management of "area wide control" is the integration of regional-scale control efforts within a specific area, including target crops, other host crops, or breeding sources, all of which are managed in a synchronized manner. The implementation in the region are under control and sustained, and the population is always maintained below the low-density level or the economic threshold. IPM is set up in area-wide control zones usually in areas with production and marketing or cooperatives. Therefore, organization of the growers can implement in the common management mode of agricultural management on the same producing crops and economic motivations to achieve the goal of high quality and high yield of crops (Fig. 1). Area wide control should cover the orchard and surrounding areas, the suspension of toxic methyl eugenol to eliminate the male for the oriental fruit fly, reduce the mating opportunities for female. When fruit harvest season, s increase and supplemented by toxic protein hydrolysate or other food bait to kill the females. It is an important task in pest control to implement in large areas to prevent and suppress the population of oriental fruit flies. Meanwhile, monitoring traps are set up to understand the distribution of fruit fly in the whole island and provide the information to make a control decision.
It is very special control issue how to suppress the ants population on the dragon fruit. In order to endanger serious *Solenopsis geminata* and *Pheidologeton diversus*, the study used the bait in the farmland to suppress the fire ant, (including 0.045% indoxacarb bait, 0.5% methoprene bait, 0.015% spinosad bait) and red imported fire ant bait of TARI technological transfer, as a result four kinds of baits can be up to 100% of the mortality rates within 2 weeks The fire ant bait and indoxacarb bait, were used after one month with the control rate of the trial zone decreased by more than 80%.

Fig. 1. Area-wide integrated pest management for the fruit flies

**CONCLUSION**

Pitaya is a continuous harvest crop in Taiwan. According to our investigation, the major pest is fruit flies, the fire ants second. But sting bugs and mealbugs were seasonal occurrence. However, it needs to develop integrated pest management to suppress the most pests. Organizing the growers and promoting the cultivation guidance is an important issue to take action in pest control in the future. Meanwhile the periodic monitoring, could be controlled in the early stages for the pests. Safety and low toxicity materials should also be engaged in suppressing the occurrence of pests on the dragon fruit.