



Red Palm Weevil Detection Methods: A Survey

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Abstract: Many pests affect plants, and these have a negatively affected agricultural production and cause a lack of quality. These causes an economic losses and high poverty rates. Many types of pests infest trees like insects, viruses, bacteria, and harmful parasitic plants. One of the most dangerous insects that infest trees such as [date, canary, sago, oil, coconut, etc...] is the Red Palm Weevil (RPW). RPW is currently considered as a global pest, killing trees, increases the tree temperature and causes water stress. It lays the eggs inside the trunk of the tree and starts feeding on the tissue of the plant, then begins to move inside the tree and still inside it until the tree dies, then begin move to the neighboring plants. The early detection of this destructive weevil is not easy; because the visible infection symptoms appear only when the infection stage is dangerous. There are many detection methods for discovering the infected trees, a Visual Inspection, Acoustic Detection, Chemical Detection, and Thermal remote sensing. In this research, we will discuss the different methods used for the early detection of this harmful weevil.

Keywords: Red Palm Weevil, Visual Inspection, Chemical Detection, Acoustic, Thermal Imaging, Early Detection.

1. Introduction

According to the global warming phenomenon that led to climate changes, many trees were affected by many diseases and agricultural pests. Although the number of pest species seems to be high, only a few species are considered major pests of economic importance. These insects often target a young tree and therefore require careful monitoring of these pests to control them. The Infested trees become harder to treated at times, but the solutions must be founded to prevent trees from the danger of these insects. There are various techniques for detection of the pest existence such as, Visual inspection, Chemical detection (trained dogs, electronic nose), Acoustics monitoring, Trap and lure evaluation and Thermal imaging. In visual inspection, the examination of the tree depends on the stage of the infestation; such as the remains of weevils around the tree, the tunnels appear on the trunk, breaking in the topping of the tree [1]. In chemical detection, a trained dog could be able to discover the infested trees with high accuracy. But it is depending on the type of the tree, as there are some types of trees are deadly for dogs. Also, the personality, ambitious and the type of the dog [1] [2]. Acoustic monitoring, as the weevils are feeding on the tissues of the trunk, sensors can be used to record the sound of chewing which originated from the pest activity [3] [4].

A thermal imaging is a type of remote sensing techniques, used to measure the radiation emitted from the tree surface and can be used in many agricultural fields such as detecting diseases that affect plants. Thermal images are obtained by portable sensors and can be mounted on a satellite or on an aircraft. The images obtained are analyzed by infrared radiation and then converted into visible thermal images. It depends on the radiation emitted by the tree, as the thermal imaging cameras can detect all objects with temperature above zero, but the radiation that arises from the surrounding environment can affect the accuracy of the image [4].

2. RPW LIFE CYCLE

Firstly, the weevil infests the tree and entering inside it, then the female weevil lays its egg inside the trunk of the tree, the egg hatches and the larva (about 5 inches) starts feeding on the soft fibers and it still entering and eating deep into the tissues of the tree until the trunk of the tree became empty. The total life cycle gets completed in 4 months, then the effect of the infestation will appeared outside the tree such as [the tunnels on the tree trunk, oozing of thick brown liquid, remains of weevils around the tree, breaking of the trunk or the topping] and all this leads to the death of the tree [5].

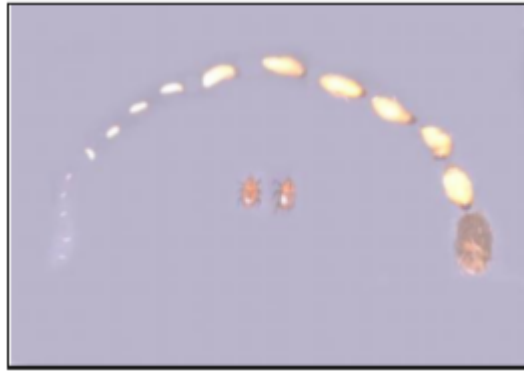


Figure (1) RPW, Life Cycle

3. CHALLENGES OF RPW

The infestation of this destructive weevil “RPW” is look like a human cancer, as the visible symptoms of infection appear only when the stage of infection is very dangerous. The infested trees are suddenly fallen. Other insects may be active around the tree. Also, there are a various types of the trees and, not all detection methods would be affected with each types of the trees [1].

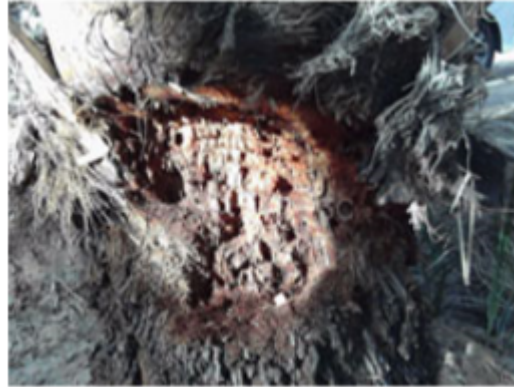


Figure (2) show holes on the palm tree trunk

4. RELATED WORK

RPW has become one of the most dangerous threaten for various types of trees such as (date, oil, coconut, sago, canary, royal, etc.....). As it does not show any visual effect until it is too late to save. So there is a need for developing an effective method helping for the early detection of the RPW in the first infestation stage. One of the most popular detection Method for RPW is the visual inspection by observing the changes that appears on the tree trunk and trying to knowing the cause of the change. When the tree is infested with this weevil, some holes will appear on the tree trunk, and a thick brown liquid, also some remains of weevils under the infested tree are found. By observing this signs in the tree trunk, this tree is infected, this is considered only a detection, but not early and we cannot save the tree life. In addition to the detection using this method is costly, it need to train the farmers firstly, and its also not accurate [4] [8]. Another way from the suggested methods is known as a chemical detection. According to the nature of dogs and its ability of smiling for a long distance. Suma et al [9] proved the ability of two types of dogs for detecting the existence of the insects in the infested trees. The experiment was as follows , dogs are trained for playing with a ball containing the ooze, hiding it in somewhere and when the dog find the ball, it will take a prize(food). Some dogs were launched at the palm tree farm and the balls which containing the ooze were hidden inside the palm tree. The dogs found the balls and also detected an infested trees which it is not known before [1]. Using traps is a popular technique that determine the presence of RPW within a certain place. But it is only defines a general area where there is an infestation. It could not identify where the specific tree is infected [6] [10]. Acoustic detection, by using a sensor to record the sound of eating, biting and movement inside the tree, Comparing between the sound level of RPW's signal activity, helped in detecting the presence of RPW inside the trunk [5]. Because of the activity of RPW larvae inside the palm trunk is audible. A portable acoustic device is proposed in [11] for the online detection of the RPW. It processes the audio signal recorded from the palm, which has been identified as the effective frequency range of the red palm weevil's acoustic emissions. The device produces a sound when RPW activity is appeared, then the human can decide whether the monitored palm is infested. With the accuracy around 97%. Another bioacoustic sensor is provided to analyze the audio recorded from inside of a palm trunk, but instead of audible tones, their device activates a red LED to indicate the existence of RPW activity. In this case, the operator training is not required. Acoustically, it is possible to detect the existence of the RPW weevil two week old [13]. As the infestation with red palm weevil causes a water stress, and this leads to a temperature increasing in the tree trunk. All objects their temperature is above the absolute zero, emit infrared rays. Thermal remote sensing "thermography" is a non-contact technology which determine a thermal property of the objects you need, converting the invisible radiation patterns of the object into a visible thermal images [14]. Thermography is currently being applied for the

specific case of RPW. And it also can be applied in many agricultural applications such as a prediction of water stress in crops, planning irrigation scheduling, prediction and detection of plant diseases.

Golomb et al. [15] suggests that it is possible to detect RPW infestation in date palms using aerial thermal imaging. firstly involved intentionally infesting trees and studying them over time, then known infested trees based on aerial thermal images and control trees. By using the watershed algorithm and the pixel- based method, it is found that the trunk of the control trees are less in temperature than the infested trees. It was found that, it is possible to use the thermal imaging technique to detect the existence of the Red Palm Weevil inside the tree trunk. But this technique is still at the initial stages of development and their equipment is expensive, [15].

5. Conclusion

In this survey we discussed the various technique for helping the early detection of the red palm weevil, but each technique faced certain limitations. Therefore, an effective Method is needed to be explored. For detecting the infestation of RPW in the various types of trees, at its early stages to save the trees life.

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