# An In-Depth Review Of Pest And Fly Control Methods In Horticulture And Agriculture

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***ABSTRACT***

*Identify plant diseases and insect pests using information and communication technology Since experts cannot physically visit farms to manage agricultural diseases and insect pests, long-distance monitoring systems are an excellent technique to improve low-tech farming practices. Numerous insect pest species can be automatically found and tracked. To enhance integrated pest management (IPM) in the context of precision agriculture, several systems have been developed. For several significant pests, automatic detection traps have been created. The early diagnosis and monitoring of diseases using these methods and new technology is very promising. The aim of the present paper is to review the techniques and scientific state of the art of the use of sensors for automatic detection and monitoring of insect pests. The study focuses on techniques for pest identification using infrared sensors, acoustic sensors, and image-based classification, covering the many systems available, examples of applications, and contemporary advancements like machine learning and the Internet of Things. Decision assistance systems and future trends in automatic traps are also covered.*

***Keywords:*** *Agriculture, Horticulture, Pest, Fly, IoT and WSN*

## 1.INTRODUCTION

One of the most significant agricultural areas in many African nations is horticulture, which helps to alleviate poverty by boosting farm earnings, creating jobs, and diversifying the economy [1]. By giving poor rural households, especially women and youth, income and employment, expanding into the agro-processing and processed food marketing, and reducing food and nutritional insecurity, diversifying into horticulture should help eradicate poverty. It will also help to restore the balance of payments by increasing total exports. The horticulture sub-sector confronts risks from insect pests notwithstanding the numerous benefits it affords for enhancing food and nutritional security and boosting the rural economies and livelihoods of the underprivileged population.

An important factor in the growth of the Indian economy is the agriculture sector. In India, the agriculture industry directly or indirectly employs more than 50% of the population. The majority of farmers—about 80%—are marginal or small farmers with holdings of no more than 2 hectares. A farmer makes very little money or loses a lot of time as a result. Natural disasters like drought and flooding are the main causes of the loss. Other factors include lower crop yield, crop quality, and costs associated with crop farming [2]. Another major concern that farmers deal with is management, where it is difficult to monitor each crop for potential disease infections and other issues. Due to the lack of historical data, farmers are less inclined to experiment with novel and hybrid crops in their area. WAN, cloud management, and low-cost IoT devices can all help Indian farmers with their problems. Because of its low cost and usefulness, [3]surveyed the use of Aurdino board in agriculture. In order to reduce labour costs and boost crop production in Mexico, he advised using IoT applications based on Arduino boards. The issues farmers confront can be overcome by fusing smart farming with modern agriculture. Placing sensors in various areas that may continuously monitor information regarding temperature, humidity, precipitation, soil conditions, including dissolved nitrogen and other mineral levels, etc., is a more hopeful answer to these issues. The farmers may also choose when to spray pesticide and the appropriate chemical formulation to remove the ailment thanks to sensors. Climate data can be studied utilizing cloud data repositories, and using past data, a more accurate forecasting model can be anticipated. A high-speed information system that can handle communication between the sensors and the object in charge of monitoring the sensors might be provided by combining the cloud with the Internet of Things. This presents a significant potential to take advantage of both technologies. For energy-constrained businesses, providing a data access strategy based on the cloud will assist close the gap between delay and energy requirements [4-5]. Additionally, the real-time data from the sensors allows the cloud-based IOT to better monitor and manage circumstances that are more challenging. Therefore, smart agriculture needs to be modeled for the advantage of small farmers as well.

For farmers, rodents and insects have long been a hassle. They eat the fruits of their labor and infest crops, dispersing numerous diseases. Therefore, it is crucial for a farmer to manage and maintain their population to preserve crop health. Insecticides and pesticides have been quite effective at preventing infestations. They do, however, have various social and environmental repercussions. Extreme pesticide application can contaminate the soil and water severely and poison plants with poisonous chemicals. Additionally, with repeated exposure, insects and bugs become resistant to them, forcing farmers to use stronger pesticides. Therefore, the main objective of intelligent horticulture is to produce high-quality fruits, vegetables, and decorative crops by using cutting-edge technologies, tools, and systems to lessen the use of human force and increase its effectiveness. Intelligent horticulture should focus on identifying horticultural crops quickly, accurately, and automatically as well as gathering planting and postharvest data [6-7]. In order to improve crop output, quality, and production costs while lowering costs for farmers of both horticulture and agriculture, the author of this research reviewed clever ways for controlling pests and fruit flies.

## 2 LITERATURE REVIEW

To locate the superior metrics in this field, a thorough and exhaustive search was undertaken using printed databases, the Internet, scientific publications, postgraduate and doctoral university theses, newspaper articles, etc. The results are quoted below.

A method using an Arduino was suggested by G. Rekh and S. Muthu Selvi[8] for organizing and expanding an agricultural system. The temperature, humidity, and soil moisture of ecological parameters were measured using sensors and the Arduino. Based on requirements employed by the weed recognition algorithm, the cloud sends the data to the farmer via message. According to estimates, this will benefit farmers throughout the state.

Crop data collection, data transmission to the end station, and video surveillance are all integrated into the system. The system offers long-distance communication, video sensors, and farm data monitoring in order to assess overall performance. [9–10] discusses the product characterization and quality of the specialized crop utilizing sensors.

By combining a centre pivot irrigation system with a wireless subterranean sensor network, Xin Dong et al.'s[11] precision irrigation system is described. Using wireless subterranean sensors, this WUS-Aided Center Pivot system has enabled autonomous irrigation control. This has been done by continuously monitoring the soil conditions. Field tests using a continuous-move centre pivot irrigation system and hydraulic drive are carried out. To assess empirical channel models for soil-air communications, the findings are used. The outcomes of the experiment demonstrate the viability of the WUSA-CP idea. When compared to traditional antenna designs, communication ranges can be increased by as much as 400% by using an underground antenna. The findings also show that a variety of spatiotemporal factors, including the placement and depth of the sensors' burial, the soil's texture and physical characteristics, the soil's moisture content, and the height of the vegetation canopy, have a significant impact on the wireless communication channel between soil and air.

In order to determine the ideal timing and volume of irrigation for maximum effectiveness, Aurelio Cano et al.[12] devised an irrigation management. The yield loss caused by crop water stress will be reduced with proper irrigation management, and the yield response to other management techniques will be increased, as well as the yield per applied unit of water. These elements influence farm profitability. The potential for profitability can be greatly reduced by irrigation management that results in either an excessive or insufficient water application. Runoff, soil erosion, and pesticide migration into surface and ground water can all be prevented with proper irrigation management. In comparison to unmanaged systems where irrigation decisions are not based on quantitative soil moisture indicators, irrigation systems coupled with proper in situ soil moisture monitoring for irrigation scheduling have significant advantages in terms of water savings as well as improving crop yields and yield quality.

A compact, sturdy quad copter that can fly for fertilizer sprayer application was designed by Emmanuel A. et. al.,[13]. The flying quad copter’s onboard camera uses image processing to detect diseased crops and water flow on the field. We utilized a flight controller called the KK multi-copter controller board to ensure the copter operated well. Gyro and accelerometer sensors are included into this controller board. The microcontroller (Atmel 164 IC) in the Arduino processes and runs the signals from these sensors, and the controller board used to drive the motors outputs the results.

A smart irrigation system based on multi-agent architecture and fuzzy logic was presented by Salazar et al. [14]. The design includes various categories of intelligent agents that autonomously monitor and are in charge of choosing whether to enable or shut the irrigation system as necessary. This proposal offers a practical and original answer to the issue of insufficient irrigation water use with current agricultural operations.

A wireless sensor network (WSN) of soil moisture, pH, and temperature sensors for data acquisition and remote control of water pumps for watering and irrigation over the Global System for Mobile communication (GSM) and Bluetooth networking were proposed by Narechania[15-16] and can be connected to an Arduino-based mobile robot to perform field operations like ploughing and seed sowing over Bluetooth channel.

Gonzales[17] created an irrigation system that strives to maximize water use using an automated irrigation mechanism. This method enables irrigation through a sensor that monitors the condition of moisture in the ground, watering the item only when you need it. Through the use of solenoid valves, the system is switched on when the humidity level is low and off when the humidity level is high. The system's logistical operations are managed by an Arduino Uno Integrated Circuit. The primary goal is to significantly reduce water usage, which will result in labor savings. The irrigation system may also be adjusted to diverse terrains, including undulating typefaces that don't need to be leveled.

To make efficient use of water for big crop fields, i.e., applying the right amount of water in the right location at the right time, Lozoya[18] introduced a model-driven control technique applied to an irrigation system. To estimate the ideal amount of water the crop needs, the suggested model employs a predictive algorithm that senses soil moisture and weather data. Based on the empirical specification of time intervals, the suggested method is compared to a conventional irrigation system and to a straightforward soil moisture control system. The adoption of a model predictive control in an irrigation system, according to the results, increases efficiency and greatly lowers water use.

Osorio[19] conducted research on automating the creation of Fustigation solutions, with the primary goal of creating a computer programme prototype and user-friendly user interface for those who need to prepare Fertigation solutions. To operate actuators and read sensor data, the programme will communicate with the Arduino platform, which functions as an electronic component. In order to send materials to a container for the manufacture of the solution, the actuators will be solenoid valves, and flow sensors will be utilised to calculate how much of each substance is required. Costs can be cut because the prototype will be made using free hardware (Arduino) and software (Java).

In order to assess the usage of programmable system on chip technology as a component of WSN to monitor the various parameters in greenhouses, D.D. Chaudhary et. al. [20] suggested a system. The technology aids in precision agriculture monitoring and management of greenhouse parameters. The potential of wireless sensor networks in automated soil moisture monitoring is explored in [21] for long-term calibration and validation applications. The network helps to monitor the soil moisture in real time and is made up of a number of automated measuring stations. As a result, the use of wireless sensor networks in agriculture aids in the gathering of meteorological, crop, and soil information as well as the monitoring of the crops and land.

Tanha Talaviya et al[22] .'s innovative automated systems supplied the need for food while also giving billions of people job opportunities. The agricultural output has been shielded by this technique from a number of circumstances, including population expansion, job issues, and food security concerns. The primary goal of this study is to evaluate the numerous ways artificial intelligence is being used in agriculture, including irrigation, weeding, and spraying with the use of sensors and other tools built into drones and robots. These technologies reduce the overuse of water, pesticides, and herbicides, preserve soil fertility, assist in the effective use of labour, increase output, and enhance product quality.

A low-cost system was developed by Kodali, R.K., and Sahu, A [23] for monitoring agricultural farms. It continuously measures the amount of soil moisture in the plants and emails or sends SMS alerts to farmers if a certain plant's moisture content is low. A moisture sensor using the Losant platform and an esp8266 microcontroller are used in this setup. For the advancement of the next generation, Losant is the most straightforward and potent IoT cloud platform. It provides the ability to view sensor data in real time from anywhere in the world, regardless of the field's location.

The design and instrumentation of variable rate irrigation, a wireless sensor network, and software for real-time in-field sensing and control of a site-specific precision linear-move irrigation system are all described in detail in a study by Kia, P.J. et al.,[24]. Six in-field sensor stations were placed across the field according to a map of the soil's properties, and they continuously sampled the field conditions and wirelessly sent the data to a base station. A programming logic controller was used to convert an irrigation system to electronic control. It updates the geo referenced location of the sprinklers using a differential Global Positioning System (GPS), and it wirelessly connects to a computer at the base station. Low-cost Bluetooth wireless radio communication was used to interface communication signals from the sensor network and irrigation controller to the base station.

Two studies that produced a mobile robot car with a camera for real-time Pyramidal species identification on the field level were proposed by Zhao et al. [25]. Applying the Distance Regularization Level Set Evolution, Aggregation Dispersion Variance (ADV), and Gaussian Mixture Model (GMM) (DRLSE). With a 95 percent accuracy rate, the authors were able to correctly identify the target species.

In order to detect Pyramidal species, Liu and colleagues [26] created a two-step recognition process that involved first using a color space (HSV) in which candidates were assessed using Otsu segmentation thresholds and then performing an object contour recognition procedure based on Hu moments. This method outperformed support vector machine detection with an accuracy of 94.3 percent.

According to the aforementioned literature review, there has been a significant advancement in on-filed pest management as a result of the implementation of the Internet of Things in the agricultural industry. Today, a farmer can employ a variety of sensors to track the expansion of pests and implement additional defenses to manage them.

**CONCLUSIONS**

The various methods of integrated pest management include the detection and monitoring of insect pests using automatic traps. The most researched systems are those that employ neural networks and image recognition, which are trustworthy for fully automated identification of orders and insect counting. However, there aren't many models that can distinguish between different species. The development of other promising image-based technologies that aim to send an insect image to a professional so that the insects can subsequently be identified and counted remotely in real time is very encouraging. Although it has been demonstrated that infrared sensor traps are effective in counting insects, their usage is constrained because they cannot distinguish between different species, which can lead to inaccurate survey results. Audio traps are another deeply studied approach for monitoring pests.

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