

# Smart Farming and Modern Entomology

**Pankaj Kumar, Vimal Kanaujiya, Ashish Pal, Kartik Rathi, Ashutosh Pal, Vikrant**  
Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut-250110

*Received: May, 2026; Accepted: May, 2026; Published: July, 2026*

## Introduction

Agriculture is undergoing a major transformation due to rapid technological advancement. Traditional farming methods are gradually being replaced by modern approaches that improve productivity, reduce crop losses and ensure sustainable agricultural development. One of the most important areas benefiting from this transformation is Entomology, particularly in the management of insect pests affecting crop production. Insects play both beneficial and harmful roles in agriculture. While pollinators and natural enemies contribute positively to crop ecosystems, destructive insect pests cause significant losses in yield and quality every

year. Farmers have relied heavily on chemical pesticides for pest control, but excessive use of these chemicals has created environmental, economic, and health-related concerns. In response, modern agriculture is increasingly adopting smart farming technologies that allow more precise, efficient and environmentally friendly pest management practices. Smart farming combines digital tools, sensors, automation, artificial intelligence, and data-driven decision-making to improve agricultural operations. In the field of entomology, these technologies are revolutionizing the way insect pests are monitored, identified, and controlled.

## Concept of Smart Farming

Smart farming refers to the application of advanced technologies in agriculture to optimize crop production and resource management. It includes the use of sensors, drones, satellite imaging, artificial intelligence, robotics, and internet-based systems to collect and analyze real-time agricultural data. The main objective of smart farming is to increase productivity while minimizing environmental

impact. By using precise information about crop conditions, soil health, weather patterns, and pest populations, farmers can make better management decisions. Smart farming is also known as precision agriculture because it focuses on applying inputs such as water, fertilizers, and pesticides only where and when they are needed.

## Modern Entomology and Its Changing Role

Modern entomology has moved beyond the traditional study of insects and now focuses on sustainable pest management strategies supported by technology and ecological understanding. Today, entomologists are using digital tools and scientific innovations to develop safer and more efficient methods for insect management. The growing demand for sustainable agriculture has increased the importance of integrated pest management,

biological control, and eco-friendly technologies. Modern entomology aims to reduce dependence on chemical pesticides while maintaining crop productivity. Technological innovations are helping researchers and farmers detect insect outbreaks earlier, monitor pest populations more accurately, and apply control measures at the right time.

## Role of Artificial Intelligence in Entomology

Artificial Intelligence is playing an important role in modern insect pest management. AI-based systems can analyze large amounts of agricultural data and identify pest problems quickly and accurately. Machine learning models are now capable of recognizing insect species through images captured by mobile phones, drones, or field cameras. These

#### Use of Drones in Pest Monitoring

Drone technology has become one of the most useful tools in smart farming. Drones equipped with high-resolution cameras can monitor large agricultural fields within a short time. In entomology, drones help in detecting pest-infested areas, assessing crop damage and monitoring insect movement. This technology

systems help farmers identify pests at an early stage, reducing crop damage and improving control efficiency. AI is also used for predicting pest outbreaks based on weather conditions, crop stages, and historical pest records. Such predictions allow farmers to take preventive actions before severe infestations occur.

reduces labor costs and provides accurate field information. In some advanced farming systems, drones are also used for targeted pesticide application. Instead of spraying the entire field, pesticides are applied only to affected areas, reducing chemical use and environmental pollution.

#### Smart Traps and Digital Pest Surveillance

Smart traps are modern insect monitoring devices that combine traditional trapping techniques with digital technologies. These traps often include sensors, cameras and wireless communication systems. One widely used technology is the Pheromone Trap which attracts specific insect pests using chemical

signals. Modern smart traps can automatically count trapped insects and send data directly to farmers through mobile applications. Digital pest surveillance systems allow continuous monitoring of insect populations and help farmers make timely pest management decisions.

#### Biological Control in Smart Agriculture

Modern entomology strongly promotes the use of biological control agents such as predators, parasitoids, and microbial pathogens. Smart farming technologies support biological control by improving pest monitoring and reducing unnecessary pesticide applications. The use of eco-friendly methods helps

conserve beneficial insects like ladybird beetles, lacewings, spiders, and pollinators. Maintaining biodiversity is essential for sustainable agricultural ecosystems. Biological pest management combined with digital monitoring creates a balanced and environmentally safe farming system.

#### Benefits of Smart Farming in Entomology

Smart farming technologies offer several advantages in insect pest management:

- Early detection of insect pests
- Reduced crop losses
- Lower pesticide consumption
- Improved environmental safety
- Better decision-making through real-time data

- Conservation of beneficial insects
- Increased crop productivity and quality
- Reduced labor requirements
- Cost-effective pest management

These benefits contribute to sustainable agricultural development and food security.

#### Challenges and Limitations

Despite its advantages smart farming in entomology also faces certain challenges.

- High initial investment for advanced technologies

- Limited technical knowledge among small farmers
- Dependence on internet and electricity
- Lack of awareness in rural areas
- Data management and privacy concerns

In developing countries, access to modern agricultural technologies remains limited for

many farmers. Training and government support are necessary for wider adoption.

### **Future Prospects**

The future of smart farming and modern entomology appears highly promising. Continuous advancements in artificial intelligence, robotics, remote sensing, and data analytics are expected to make pest management more precise and efficient. Future agricultural systems may include fully automated pest detection devices, robotic pest

control systems, and AI-driven advisory platforms. These innovations will help reduce environmental risks and improve sustainable food production. Climate change is also increasing the importance of smart pest management strategies, as changing environmental conditions influence insect behavior and distribution.

### **Conclusion**

Smart farming and modern entomology are transforming agriculture by introducing advanced, efficient, and sustainable pest management practices. The integration of artificial intelligence, drones, smart traps, and biological control methods is helping farmers reduce pesticide dependence while improving crop protection. As agriculture continues to face challenges related to climate change,

population growth, and environmental sustainability, technology-based insect management systems will play a vital role in securing future food production. Promoting awareness, farmer training, and technological accessibility will be essential for achieving sustainable and smart agricultural development.