



## Popular Article

Domain: **Agriculture Science**

Vol 4 Issue 11, November 2025, 5500-5503

# Emerging Insect-Borne Diseases: Challenges and Control Strategies

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[DOI:10.5281/TrendsInAgri.17642390](https://doi.org/10.5281/TrendsInAgri.17642390)

### *Abstract*

Emerging insect-borne illnesses are posing a huge danger to agriculture, livestock, and human health throughout the world. Climate change, global commerce, habitat modification, and pesticide resistance are hastening the spread of new and re-emerging vector-borne diseases. Mosquitoes, biting midges, whiteflies, aphids, and leafhoppers spread viruses, germs, and parasites that reduce agricultural output and result in significant economic losses. This article explores the primary insect-borne illnesses that are growing in agriculture, discusses the problems of diagnosis and surveillance, and reviews current and sustainable management measures. The emphasis is on molecular diagnostics, integrated vector management, host resistance, and ecological techniques that improve resilience to vector-borne diseases.

**Keywords:** Insect vectors, emerging diseases, climate change, integrated pest management, vector ecology, plant viruses.

### **Introduction**

In recent decades, insect-borne illnesses have become more prevalent as a result of fast climatic changes, rising temperatures, and more cross-border movement of plant materials. Many insect vectors are gaining resistance to routinely used pesticides, rendering traditional control tactics ineffective. Emerging insect-borne infections, including viruses like Tomato yellow leaf curl virus (TYLCV), Rice tungro virus, and phytoplasmas, represent significant threats to global food security.

Smallholder agricultural systems are especially susceptible due to a lack of effective

diagnostic and management technology. The complexities of vector-pathogen-host relationships necessitate comprehensive, long-term tactics rather than quick pharmacological fixes. Understanding these relationships is critical for developing effective control methods.

## Major Emerging Insect-Borne Diseases in Agriculture

### 1. Phytoplasma-Associated Diseases

- **Maize bushy stunt disease:** spread by *Dalbulus maidis*.
- **Sugarcane grassy shoot disease:** transmitted by leafhoppers.

Phytoplasmas live in plant phloem and can only be detected with specialized molecular instruments.

### 2. Viral Diseases

- **Tomato yellow leaf curl virus (TYLCV):** *Bemisia tabaci* (whitefly) causes severe stunting and leaf bending in tomatoes.
- **Rice tungro disease:** Green leafhoppers spread the rice, causing stunting and sterility.
- **Citrus tristeza virus (CTV):** Brown citrus aphids transmit the disease, causing citrus groves to decrease.

### 3. Vector Dynamics

- Many vectors reproduce quickly, flourish in warm temperatures, and travel vast distances, resulting in fast disease epidemics.

### 4. Bacterial and Parasitic Diseases

- **Xylella fastidiosa:** Sharpshooters disseminate it, resulting in severe dieback in grapes and olives.
- **Trypanosomiasis (in livestock):** It is carried by biting flies and has an impact on rural agricultural systems.

### ➤ Challenges in Diagnosis and Surveillance

1. **Multiple Vector Species:** Multiple insects may transmit a single infection, complicating surveillance efforts.
2. **Rapid spread:** Insect vectors may travel huge distances in days, allowing illnesses to spread fast.
3. **Non-specific or hidden symptoms:** Early infection signs might mimic nutritional deficits, drought stress, or fungal infections, making field identification challenging.
4. **Limited Diagnostic Tools in Field Conditions.**
  - Traditional microscopy and symptom monitoring are inaccurate.
  - Phloem-restricted infections are difficult to grow.

### 5. Climate-Driven Shifts

Rising temperatures broaden vector geographic ranges, allowing illnesses to infiltrate

previously untouched areas.

### ➤ **Modern Diagnostic Technologies**

#### **Remote sensing and Digital Surveillance**

- Drones and spectral imaging can identify early crop stress.
- Mobile applications and AI models enable real-time reporting of vector outbreaks.

#### **Molecular Tools**

- PCR and qPCR provide accurate detection of viruses, bacteria, and phytoplasmas.
- LAMP tests provide quick, on-site diagnostics for rural applications.
- NGS identifies undiscovered or emerging diseases in vector populations.

### ➤ **Control and Management Strategies**

#### **1. Host Plant Resistance**

The most successful long-term strategy is to develop cultivars that are resistant to viral or phytoplasma infections. Examples include

- TYLCV-resistant tomato hybrids.
- Rice types with Tungro tolerance
- Citrus rootstocks resistant to CTV.

#### **2. Integrated Vector Management (IVM)** includes biological, cultural, mechanical, and chemical techniques.

- a. Removing substitute host plants.
- b. Monitoring vector numbers with sticky traps and pheromone traps.
- c. Using insecticides based on economic thresholds.
- d. Release of biological control agents
- e. Enhancing ecological equilibrium.

#### **3. Biological Control**

- f. Predators including ladybird beetles, lacewings, and parasitoids can lower whitefly and aphid populations.
- g. Entomopathogenic fungi, such as *Beauveria bassiana*, reduce vector populations.

#### **4. Chemical Control**

Use only when necessary to do:

- To avoid the danger of developing resistance
- Harm to beneficial insects.
- Environmental pollution.

Rotating insecticides and adopting selective products helps extend their efficacy.

#### **5. Cultural practices** include field cleaning, synchronized planting, crop rotation, and the use of mulch or reflective coatings to limit vector landings.

## 6. Climate-Smart Approaches

- Moisture regulation
- Habitat diversification
- Shade management

These methods reduce vector survival and disease incidence.

## Future Prospects

Advances in genome editing (CRISPR), RNA interference (RNAi), and Wolbachia-based vector control show promise in diminishing viral competence. Improving early warning systems and encouraging community-based pest control will increase resistance to emerging insect-borne disease risks. Increased investments in surveillance networks, breeder-pathologist collaboration, and farmer training are critical to long-term disease control.

## Conclusion

Emerging insect-borne illnesses pose a rising threat to global agriculture, driven by climate shifts, ecological imbalances, and vector adaptation. Accurate diagnosis, real-time surveillance, and integrated control mechanisms are critical to limiting these dangers. Sustainable management necessitates a mix of technical innovation, environmental principles, and farmer empowerment. A comprehensive, integrated strategy will be critical in protecting crop health and guaranteeing food security in the face of developing insect-borne illnesses.

## References

- Kumar, P. L., & Reddy, R. V. (2022). Emerging insect-borne plant viruses and their management. *Plant Pathology Journal*, 38(4), 215–230.
- Fereres, A., & Raccach, B. (2015). Plant virus transmission by insects. *Annual Review of Entomology*, 60, 387–409.
- Navas-Castillo, J., Fiallo-Olive, E., & Sanchez-Campos, S. (2011). Emerging virus diseases transmitted by whiteflies. *Annual Review of Phytopathology*, 49, 219–248.
- Hogenhout, S. A., Oshima, K., Ammar, E. D., Kakizawa, S., Kingdom, H. N., & Namba, S. (2008). Phytoplasmas: Bacteria that manipulate plants and insects. *Annual Review of Phytopathology*, 46, 57–81.
- Jones, R. A. C. (2021). Global plant virus disease emergence and climate change. *Virus Research*, 308, 198628.
- Purcell, A. H. (2013). Paradigms for insect-borne plant pathogens. *Annual Review of Phytopathology*, 51, 15–36.
- Singh, B., & Kaur, G. (2020). Sustainable management of whitefly-transmitted viruses. *Journal of Entomological Research*, 44(3), 345–356.
- Rosa, C., & Kuo, Y. W. (2019). Plant virus transmission mechanisms by insects. *Current Opinion in Virology*, 33, 199–208.
- Strange, R. N., & Scott, P. R. (2005). Plant disease: A global threat to food security. *Annual Review of Phytopathology*, 43, 83–116.
- Millet, B., Brown, J. K., & Byrne, F. J. (2019). Whitefly genomics and insecticide resistance. *Pest Management Science*, 75(2), 310–322.