



5TH INTERNATIONAL SYMPOSIUM ON FOREST ENTOMOLOGY AND PATHOLOGY (IFEPS 2026) DECLARATION OF OUTCOMES

I. About the Symposium

The 5th International Symposium on Forest Entomology and Pathology (IFEPS 2026) was hosted by Kastamonu University and held in Kastamonu, Türkiye, from 7 to 9 May 2026.

A total of 165 participants attended the symposium, including scientists and researchers from various universities in Türkiye and the Forestry Research Institutes affiliated with the General Directorate of Forestry, as well as participants who joined online from Georgia, Azerbaijan, Italy, Poland, Canada, Chile, and Albania. The programme included 33 oral presentations and 10 poster presentations. Prof. Dr. Sabri ÜNAL served as Chair of the Organizing Committee, while Prof. Dr. Asko Tapio LEHTIJARVÍ (Isparta University of Applied Sciences) and Prof. Dr. Mustafa YAMAN (Bolu Abant İzzet Baysal University) participated as invited speakers.

Within the fields of forest entomology and pathology, IFEPS 2026 brought together researchers and representatives of relevant institutions working on forest health, invasive alien species, biological control, forest biosecurity, climate change, and sustainable forest management on a common scientific platform.

The invited presentations, oral and poster presentations, and scientific discussions held during the symposium contributed to the assessment of biotic and abiotic threats affecting forest ecosystems in light of current scientific knowledge, the identification of research priorities, and the development of solutions for forestry practices.

This Declaration of Outcomes reflects the shared views and priorities that emerged from the presentations and scientific discussions held during the symposium.

Participants emphasized that forest health is influenced not only by pests and pathogens but also by interacting factors, including climate change, drought, land-use change, global trade, and human activities. Accordingly, strengthening interdisciplinary research, translating scientific knowledge into forestry practice, and expanding national and international collaboration were identified as key priorities. It was also emphasized that healthy forest ecosystems are of strategic importance for biodiversity conservation, carbon storage, water-resource conservation, and human well-being. The joint assessments and recommendations of the symposium are presented below.

II. Scientific Assessments

1. Climate Change and Forest Health

Studies presented at the symposium indicated that climate change is one of the major environmental stressors affecting forest ecosystems. Rising temperatures, altered precipitation regimes, and drought can affect tree physiological resilience, the distribution of insect pests and pathogens, and their population dynamics.



Participants recommended integrating climate-scenario-based risk assessments, species distribution modelling, and long-term monitoring into forest planning and identified the development of climate-resilient, biodiversity-rich forest ecosystems as a priority for sustainable forest management.

2. Drought, Environmental Stress Factors, and Forest Decline

The studies presented indicated that drought and other environmental stressors can substantially affect forest health by reducing tree defensive capacity and thereby potentially increasing damage caused by bark beetles and opportunistic pathogens.

Participants emphasized that tree mortality and forest decline may result from interactions among climatic conditions, soil properties, nutritional status, stand structure, and biotic factors. They recommended implementing long-term monitoring programmes, expanding soil and foliar analyses, and developing early-warning systems. They further concluded that forest health management practices should be planned with due consideration of regional ecological conditions and local risk factors.

3. Invasive Alien Species and Forest Biosecurity

Research presented at the symposium highlighted how global trade and climate change can accelerate the spread of invasive alien species, thereby posing substantial biological and economic risks to forest ecosystems. Studies focusing particularly on *Dryocosmus kuriphilus*, *Leptoglossus occidentalis*, and *Cydalima perspectalis* indicated that early detection, systematic field surveillance, risk assessment, and rapid response are fundamental components of forest biosecurity.

Participants emphasized the need to strengthen quarantine measures, enhance international data sharing, and improve coordination among relevant institutions.

4. Integrated Pest Management and an Ecosystem-Based Approach

Studies discussed during the symposium highlighted the importance of adopting an Integrated Pest Management (IPM) approach that integrates pest biology, population dynamics, and ecosystem processes, rather than relying on a single control method for forest pest management.

Participants emphasized that, in addition to decision-making based on regular monitoring and risk assessment, appropriate management options—including mechanical, biological, cultural, and biotechnical methods—should be evaluated in relation to pest characteristics and population levels, ecological conditions, and potential effects on non-target organisms.

Where chemical control is considered necessary, its use should be evaluated in accordance with applicable legislation and permitting procedures, with due consideration given to environmental impacts and ecosystem integrity.

5. Biological Control and Conservation of Natural Enemies

Assessments conducted during the symposium indicated that biological control is a key component of sustainable and environmentally sound forest management practices. Research focusing particularly on *Rhizophagus grandis*, *Thanasimus formicarius*, *Torymus sinensis*, and *Trissolcus japonicus* indicated that biological control can provide effective pest-management outcomes.

Participants emphasized that biological control should not be regarded solely as the release of natural enemies, but should be planned in conjunction with habitat conservation and connectivity, and the



maintenance and support of natural-enemy populations. Regular monitoring and scientific evaluation of field-based biological control programmes were considered essential for assessing their effectiveness and informing the development of management strategies. Further research on indigenous natural-enemy species and more effective integration of biological control programmes into forestry policies were recommended.

6. Silvicultural Practices and Ecosystem Resilience

The topics addressed at the symposium supported the view that silvicultural practices are fundamental management tools for enhancing the resilience of forest ecosystems to pests, pathogens, and climate change.

The establishment of mixed-species stands, support for natural regeneration, appropriate tending operations, and conservation of local genetic resources were considered important for enhancing ecosystem resilience. Participants stated that silvicultural planning should adopt an integrated approach that considers biodiversity, ecosystem services, and climate change adaptation, and that nature-based solutions (NbS) can support this process.

7. Forest Health and Sustainable Management in Protected Areas

Studies conducted in protected areas indicated that biodiversity conservation is a fundamental priority; however, scientifically informed and sustainable management approaches may also be necessary for the management of forest pests and pathogens.

Participants emphasized that management strategies should consider conservation objectives and ecosystem integrity in an integrated manner, that interventions should be based on scientific risk assessments, and that decision-making should be supported by long-term monitoring data.

8. Remote Sensing, Geographic Information Systems, and Artificial Intelligence-Supported Applications

The studies presented demonstrated that remote sensing, geographic information systems (GIS), unmanned aerial vehicles (UAVs), satellite data, and AI-based analyses offer substantial opportunities for monitoring forest health. These technologies can facilitate the early detection of changes associated with pests and pathogens, the generation of risk maps, and the development of decision-support systems. Participants considered that integrating these technologies with field observations could make important contributions to forestry practices.

9. Molecular Diagnostic Methods and Early Detection

Scientific assessments conducted during the symposium demonstrated that molecular diagnostic methods offer important advantages for the rapid and reliable identification of pests and pathogens.

DNA barcoding, real-time PCR (qPCR), environmental DNA (eDNA) analyses, and metagenomic approaches were considered valuable tools, particularly for detecting organisms of quarantine significance. Participants emphasized that strengthening molecular diagnostic infrastructure, developing standardized diagnostic protocols, and strengthening specialized human resources and technical capacity should be national priorities for forest biosecurity.



10. Soil Health, Nutritional Status, and Conservation of Genetic Diversity

Studies presented at the symposium demonstrated that soil properties, nutrient balance, and environmental stressors play important roles in determining forest ecosystem resilience. Nutrient imbalances and prolonged drought were considered capable of increasing tree susceptibility to pests and pathogens.

Participants emphasized that soil and foliar analyses should constitute core components of long-term forest health monitoring programmes and that conserving genetic diversity is of strategic importance for developing climate-resilient forests.

11. Urban Forests, Public Awareness, and Forest Biosecurity

Urban forests and other urban green spaces can represent important risk areas for the introduction, establishment, and spread of invasive alien species. Accordingly, regular risk-based surveillance in urban areas, strengthened biosecurity measures, and enhanced inter-institutional collaboration were emphasized.

Participants considered that increasing public awareness and systematically assessing observations and reports concerning invasive species could support early detection and surveillance activities.

12. Bioindicator Species and Ecosystem Services

Research presented and assessments conducted at the symposium highlighted the roles of insects and other invertebrates in maintaining ecosystem functions and their potential as bioindicators for monitoring environmental change.

Participants emphasized that biodiversity conservation is fundamental to ecosystem functioning and resilience and that interdisciplinary collaboration should be strengthened to jointly assess biodiversity, ecosystem functions, and environmental change in forest health research.

13. Early Detection and Management of Forest Diseases and Pathogens

Early and accurate diagnosis of diseases in forest ecosystems, particularly those caused by fungal pathogens, together with regular monitoring, was considered essential for maintaining forest health. In this context, complementing field observations with laboratory analyses and molecular diagnostic methods was considered important for the accurate and rapid identification of pathogens.

It was concluded that the effects of climate change, drought, and other environmental stressors on disease development and spread should be taken into account; early-warning and long-term monitoring systems should be strengthened; and the resulting data should be incorporated into forest health management.

14. Future Research Priorities



Participants recommended that the following research areas be supported:

- Assessment of the effects of climate change on pests and pathogens through long-term monitoring;
- Development of species distribution models and risk assessments based on climate scenarios;
- Investigation of the roles of indigenous natural enemies and the forest microbiome in biological control;
- Advancement of research on the use of artificial intelligence, remote sensing, and molecular diagnostic methods in forestry decision-support processes;
- Support for research aimed at the conservation and sustainability of genetic diversity and ecosystem services.

15. Strengthening National and International Scientific Collaboration

Participants emphasized that forest health challenges associated with pests and diseases require attention at both national and international levels because of their transboundary impacts and the need for coordinated management. Strengthening scientific data sharing, joint research projects, researcher exchange programmes, and scientific training and capacity-building activities was considered important for advancing forest biosecurity, climate change adaptation, and sustainable forestry practices.

III. Joint Recommendations for Forestry Policies and Practices

Based on the scientific assessments arising from the symposium, the following recommendations were adopted:

1. Climate change adaptation should become a core component of forest management plans.
2. The national forest health monitoring system should be developed as an integrated framework combining field surveys, remote sensing, and molecular diagnostic methods.
3. Integrated Pest Management (IPM) and biological control programmes should be expanded.

The following sub-recommendations were developed to enhance the effectiveness of biological control programmes:

a) Health and Quality Management of Predatory Insects in Biological Control Programmes

Research and assessments presented at the symposium indicated that health and quality problems associated with the mass rearing and field release of predatory insects such as *Calosoma sycophanta* and *Rhizophagus grandis* may adversely affect the efficacy of biological control. Infections caused by entomopathogens were considered a potential factor contributing to reduced field effectiveness among released predators and high mortality rates in laboratory colonies. It was emphasized that the effectiveness of biological control should be evaluated not only on the basis of the number of individuals released but also by considering their health and quality attributes.

b) Hygiene and Health Protocols in Biological Control Laboratories

Standardized hygiene and biosecurity protocols should be implemented in biological control laboratories. Infections in predator colonies may be associated with prey organisms used for rearing, laboratory conditions, or other sources of contamination. The possibility that certain pathogens may be transmitted



from parental stock to subsequent generations should also be considered. Accordingly, parental stock should be screened for potentially hazardous pathogens using appropriate molecular and microscopic methods.

It was recommended that individuals intended for field release be screened for pathogens using appropriate molecular and microscopic methods on the basis of risk assessment and that their health status be documented. Strengthening specialist expertise and in-service training capacity in the relevant laboratories was considered necessary for the effective implementation of these practices.

c) Risk Assessment of Pathogen Carriage by Predatory Insects

Calosoma sycophanta may contribute to the mechanical carriage and dissemination of certain entomopathogens; therefore, predator–pathogen–prey interactions should be further investigated in the context of biological control. Accordingly, in addition to their predation efficacy, the potential role of predatory insects in carrying and disseminating pathogens should also be assessed. The potential consequences of these interactions for the target pest, predator, and non-target organisms should be investigated. Therefore:

- Prior to the release of predatory insects, the baseline pathogen load within the target pest population should be determined.
- Appropriate analyses should be conducted to determine whether the predatory insects intended for release carry any of the pathogens detected in the target pest population.
- The predation activity of predatory insects and their potential to carry and disseminate pathogens should be assessed jointly within an Integrated Pest Management (IPM) framework.

These three sub-recommendations highlight the importance of strengthening not only rearing activities in biological control laboratories but also health, quality-control, and biosecurity procedures. Incorporating these measures into the biological control programmes of relevant institutions would contribute to more efficient resource use and the development of sustainable forest health management practices.

4. Biosecurity, risk assessment, and early-warning systems targeting invasive alien species should be strengthened.
5. Silvicultural practices should be planned in accordance with the principles of biodiversity conservation, ecosystem resilience, and climate change adaptation.
6. Research on soil health, genetic diversity, and technological infrastructure should be supported.
7. National and international collaboration among universities, research institutions, and relevant stakeholders should be strengthened.

IV. Overall Conclusions and Joint Assessment

The 5th International Symposium on Forest Entomology and Pathology (IFEPS 2026) made a significant contribution to assessing the biotic and abiotic threats affecting forest ecosystems in accordance with current scientific approaches and to developing shared perspectives on sustainable forest management.



Studies presented at the symposium indicated that the effects of climate change, drought, invasive alien species, and other environmental stressors on forest health should be addressed through an integrated approach. In this context, early-warning systems, biological control, molecular diagnostic methods, remote sensing technologies, and evidence-based management were considered likely to play an increasingly important role in future forestry practices.

Participants emphasized the strategic importance of forest health for biodiversity, ecosystem services, carbon storage, water-resource conservation, and climate change adaptation. They also agreed that strengthening interdisciplinary research and national and international collaboration, together with translating scientific knowledge into practice, constitutes a fundamental priority for sustainable forest management.

The assessments and recommendations presented in this Declaration of Outcomes are expected to contribute to scientific research, forestry practices, and the development of national forestry policies.

V. Acknowledgements

This Declaration of Outcomes was prepared on the basis of the collective scientific assessments of the participants of the 5th International Symposium on Forest Entomology and Pathology. We sincerely thank all scientists who contributed to the organization of the symposium, the members of the Organizing and Scientific Committees, the supporting institutions and organizations, and all participants.