



ENTOMOLOGY AND THE FUTURE OF SUSTAINABLE AGRICULTURE

ESA Transition Document

OVERVIEW

With member scientists on the front lines of agricultural innovation, the Entomological Society of America (ESA) recognizes the urgent need to transform how we grow food, fiber, fuel, and feed. To ensure our nation's long-term food security, we propose a three-pronged approach for the next administration: 1) Empower innovation through precision monitoring and forecasting; 2) Cultivate tomorrow's farmers by investing in education and extension services; 3) Foster progress by updating regulatory frameworks for emerging technologies.

CHALLENGES

The U.S. agricultural landscape is rapidly changing, with modern practices, climate change, and evolving pests introducing new challenges. Outdated methods are no longer sufficient; we need 21st-century solutions to manage pests effectively. Pests reduce crop yields and quality, with global losses estimated by the Food and Agriculture Organization to account for 20-40 percent of global crop production annually. Embracing innovations like indoor farming, hydroponics, and aquaponics offers promise but requires specialized pest management strategies. Investing in targeted research and centralized data collection is crucial for developing effective pest control and providing farmers with the right crop varieties. Additionally, our reliance on diminishing chemical options is unsustainable due to resistance and ecosystem damage. Improving communication and collaboration across agriculture sectors can enhance data sharing and pest prediction, leading to more effective management. By uniting researchers, growers, and stakeholders, we can build a sustainable and productive agricultural future.

RECOMMENDATIONS

ESA proposes a data-driven, multi-pronged approach, leveraging cutting-edge science and technology to ensure the resilience of the U.S. agriculture sector amidst a rapidly changing environment, unpredictable weather patterns, and other emerging threats.

Empower Innovation Through Precision Monitoring and Forecasting. The agricultural landscape is facing a multitude of challenges, from unpredictable weather patterns to the emergence of invasive species. Traditional, calendar-based pest management practices are no longer sufficient, and there is an urgent need to shift to real-time responsiveness. The integration of affordable monitoring tools like drones, sensors, and satellites with AI-powered predictive models can result in an “agricultural weather forecast” for pests that will enable:

- *Precision Pest Management.* Real-time data on pest location and population dynamics will inform targeted interventions, minimizing unnecessary chemical use and maximizing effectiveness. This not only reduces environmental impact but also slows the development of pest resistance, ensuring the long-term viability of these control methods.
- *Centralized Monitoring System.* Currently, pest data is fragmented and difficult to access. A centralized, open-source platform would aggregate information on pest populations across all crops, providing farmers with a comprehensive view of pest threats in their region. This readily available, searchable information empowers informed decision-making, allowing farmers to proactively address potential outbreaks before they cause significant damages.



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- *Proactive Defense Against Invasive Species.* Open-source ecological modeling can analyze vast datasets to predict the arrival and spread of invasive species. This early warning system allows for rapid response measures, such as quarantines or the introduction of natural predators, preventing these new threats from establishing themselves and causing widespread devastation.

Bridging the Knowledge Gap: Empowering Farmers for a Sustainable Future. The success of any scientific advancement hinges on its translation from the lab to the real world. In the case of our efforts to transform U.S. agriculture, empowering farmers with the latest knowledge and tools is paramount. This necessitates a robust investment in extension programs, a crucial bridge between cutting-edge research and rural communities. Increased funding for extension services at the U.S. Department of Agriculture (USDA) and state agricultural departments as well as increased outreach support for the U.S. Environmental Protection Agency (EPA), would yield significant benefits:

- *Farmer Empowerment.* Equipping farmers with the knowledge and tools to implement new, sustainable pest management practices is essential. Extension programs can provide training on next-generation integrated pest management (IPM) strategies like RNAi technology and AI-powered precision management. This not only improves yields and reduces environmental impact but also empowers farmers to make informed decisions about their land and crops.
- *Closing the Innovation Gap.* The rapid pace of scientific discovery can leave farmers behind. By effectively communicating research advancements through extension programs, we can ensure their swift adoption in the field. This accelerates progress towards a more sustainable agricultural future, minimizing reliance on traditional chemical control methods and fostering a more environmentally friendly approach to pest management.
- *Solidifying U.S. Leadership.* A well-informed agricultural sector positions the U.S. as a global leader in sustainable food production. By fostering knowledge transfer through extension programs, we can empower American farmers to become not just adopters, but also innovators in sustainable practices. This not only strengthens U.S. agriculture domestically but also positions it as a role model for other nations facing similar challenges.

Investing in extension services is more than just a budgetary line item; it's an investment in the future of U.S. agriculture. By empowering farmers with knowledge and fostering a culture of continuous learning with support from extension professionals and crop consultants, we can ensure a thriving, sustainable agricultural sector that feeds a growing population while safeguarding our environment for generations to come.

Foster Progress by Updating Regulatory Frameworks for Emerging Technologies. In addition to the development of genetic modification and precision breeding in recent decades, U.S. federal policy must keep pace with cutting-edge technologies that prevent and control pest outbreaks in our farms and forests. To drive innovation and improve technological competitiveness, we recommend investing in next-generation IPM that moves beyond traditional methods to fund research on cutting-edge technologies like:

- *RNA Interference (RNAi).* This technique disrupts the genetic machinery of pests, offering a highly targeted approach with minimal environmental impact.
- *Insect Behavior Manipulation.* Understanding and manipulating insect behavior could lead to novel control methods, such as using pheromones to disrupt mating or deter pests from crops.
- *AI-Powered Precision IPM.* By integrating artificial intelligence with real-time data on pest populations and environmental conditions, we can create smarter, more targeted interventions, optimizing resource use and minimizing environmental damage.
- *Insects as a Solution.* Insects can be utilized for waste management, converting agricultural waste into valuable resources like fertilizer or energy. Additionally, insects can be mass-reared as a high-efficiency protein source for fish and poultry farming, reducing reliance on unpredictable foreign markets and strengthening U.S. agricultural resilience.



These novel approaches hold immense promise for safeguarding long-term agricultural sustainability. By investing in research, we can develop effective and environmentally friendly pest control strategies that minimize harm to soil and local ecosystems, ultimately leading to higher yields and a more resilient agricultural sector.

We also recommend streamlining regulations to embrace innovation, as outdated regulatory frameworks pose a significant hurdle to progress. The U.S. needs to modernize its approach by:

- *Expediting Approval Processes.* Streamline the approval process for safe and effective new pest control technologies, including gene drives and RNAi. Antiquated regulations create a bottleneck, stifling innovation and hindering U.S. competitiveness on the global stage.
- *Encouraging Public-Private Partnerships.* Foster collaboration between government agencies, research institutions, and the private sector to accelerate the development and commercialization of these promising new technologies.

By prioritizing research funding and implementing clear, efficient regulatory frameworks, we can unlock a new era of sustainable pest management in U.S. agriculture. This will not only ensure a thriving agricultural future but also position the U.S. as a global leader in innovation and environmental stewardship.

Bringing it Home Through Extension Education and Outreach

To maximize return on investment in the world-leading work of our federal and university scientists, we need to emphasize and support programs that provide education, support services, extension and outreach to our rural agricultural communities. Support is also needed to train the future sustainable agricultural research workforce. All of this can come in the form of expanded grants or line items for agencies such as USDA, EPA, and the National Science Foundation.

The Entomological Society of America is the largest organization in the world serving the needs of entomologists and other insect scientists. ESA stands as a resource for policymakers and the general public who seek to understand the importance and diversity of earth's most diverse life form—insects. Learn more at www.entsoc.org.

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