U.S. Agriculture is Vulnerable to Weeds, Diseases, Insects and Other Pest Threats

Ongoing Investment in Integrated Pest Management Safeguards America's Agricultural Industry and Food Supply

Executive Summary

One Critical Lesson of COVID: Agriculture is the Vital American Industry

In 2020, the importance – and fragility – of American agriculture was made clear when COVID-related disruptions resulted in empty store shelves and food rationing for the first time in most Americans' lives.

The reality COVID drove home is that agriculture is *the* vital American industry, not just contributing $1 trillion to the U.S. economy and supporting more than 22 million jobs, but ensuring families have safe, affordable food.

But U.S. agriculture is threatened by invasive and native insects, weeds and diseases, which cost billions annually in control costs and harvest losses. Invasive pests are especially serious because they disrupt effective controls and can cause significant enviromental and economic damage.

Long-term control of pests is best achieved by integrated pest management, science-driven strategies that minimize health and environmental risks while providing cost-effective control.

But because pest challenges change and evolve, integrated pest management must also constantly adapt. Ongoing investments in research and extension outreach are needed to safeguard America's agricultural industry and the nation's food supply.

An Issue Paper by the National Integrated Pest Management Coordinating Committee, representing U.S. Land-grant Universities, Regional and National Technical Committees and the U.S. Department of Agriculture's Regional Integrated Pest Management Centers

An Unsettling Realization: American Agriculture is Uncomfortably Fragile

The COVID pandemic illuminated many truths about the U.S. economy but few more important than this: Agriculture is the vital American industry.

That point was driven home by empty store shelves, rationed quantities of staples like flour, meat and eggs, and panic buying of food. In 2020, for the first time in most Americans' lives, there was no guarantee that the food they wanted to buy for their families would be available. Until COVID-19, food rationing hadn't happened in the United States since World War II. For the 92 percent of the U.S. population born after 1945 – 300 million of our 328 million citizens – food rationing was a new and disquieting experience.

It also made two realities very clear: American agriculture is absolutely vital, and American agriculture is uncomfortably fragile.

Fortunately, the immediate COVID-related market disruptions were short-lived as an innovative agricultural industry retrenched, redistributed and repackaged goods to get them to market. The longer-term impacts of the pandemic are still unknown and the vulnerability of agricultural workers in fields, packing house and processing plants remains concerning.

And while COVID is caused by a human pathogen that came to U.S. shores, our agricultural industry also faces constant threats from other invasive diseases, insects and weeds, including pathogens that infect livestock but can mutate to become dangerous diseases in people. Before 2020, conventional wisdom held that the U.S. agricultural infrastructure was robust enough to manage even a widespread outbreak without severe disruptions to our food supply or consumer markets, but COVID challenged that conventional wisdom.

U.S. agriculture is also vulnerable to domestic pests. Climate change is exacerbating that vulnerability by increasing the geographic range pests can live and how often they reproduce in a given season. That increases how often growers must manage them during longer, hotter, unpredictable growing seasons which in turn creates more opportunities for pests to become resistant to pesticides or other control methods, making them even more difficult and expensive to manage.

To safeguard and increase resiliency in American agriculture, our farmers, ranchers and land managers must have the tools they need to manage pests safely and effectively using a science-based approach known as integrated pest management. Ongoing support for the public scientists at our land-grant universities and agricultural research stations who create these tools is vital.

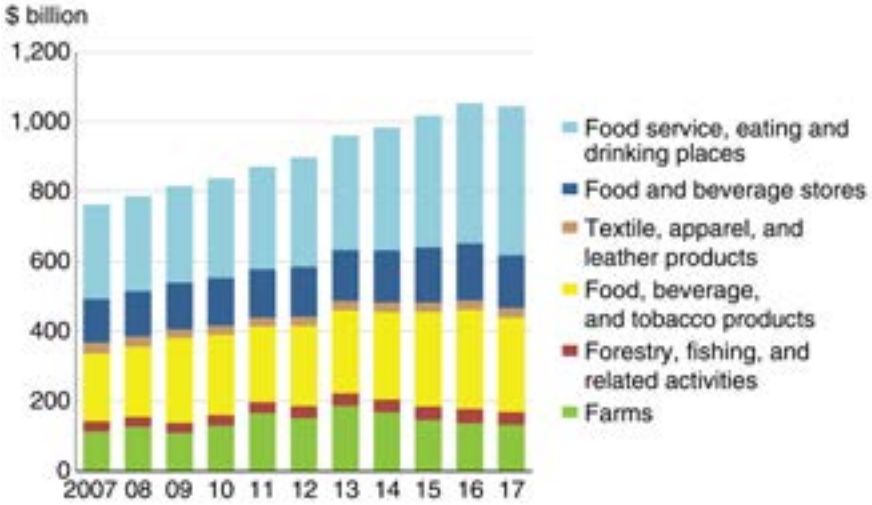
The Economic Importance of U.S. Agriculture

Agriculture, food and related industries contributed $1.053 trillion to U.S. gross domestic product in 2017, a 5.4-percent share. (USDA Economic Research Service, 2020) The output of America's farms contributed $132.8 billion of this sum – about one percent of GDP. However, the overall contribution agriculture is actually much larger because sectors related to agriculture – forestry, fishing and related activities; food, beverages and tobacco products; textiles, apparel and leather products; food and beverage stores; and food service, eating and drinking places – rely on agricultural inputs in order to contribute added value to the economy.

In addition, 22 million full- and part-time jobs were related to the agricultural and food sectors in 2018 – 11 percent of total U.S. employment. Direct on-farm employment accounted for about 2.6 million of these jobs, or 1.3 percent of U.S. employment, while employment in agriculture- and food-related industries supported another 19.4 million jobs. Unlike jobs in schools or the retail sector, agricultural jobs are not evenly distributed across the country or even individual states. Instead, in many rural areas, agriculture is a primary industry and largest employer.

But for most Americans, agriculture simply means food. Agriculture means abundant and affordable plant and animal products; a healthy dinner on the table every night, or fresh snacks after school. American households spend 13 percent of their total expenditures on food, behind only housing and transportation. The banking and insurance industries contribute more to the U.S. GDP annually, but families cannot feed their children an insurance policy.

Value added to GDP by agriculture and related industries, 2007-17



Note: GDP refers to gross domestic product.
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of Economic Analysis, Value Added by Industry series.

Pests Are a Constant Threat to Agriculture, Especially Invasive Species

The $132 billion in annual farm output noted above is produced in the face of constant pressure from insects, plant diseases, weeds and crop-killing animals ranging from voles to birds to feral hogs.

Spotted laternfly. Photo: Pennsylvania department of Agriculture

These pests are endemic to agriculture and American farmers spent $9 billion on crop-protecting chemical pesticides – herbicides, insecticides and fungicides – in 2019 alone. That figure does not include the costs of application, nor does it capture all the other ways growers manage pests (Mordor Intelligence 2020).

Despite those billions spent, pests still cause significant crop losses in the United States and worldwide. U.S. growers lose an estimated 10 to 35 percent of their crops to pests, representing a severe economic loss to individuals, rural communities and the nation, but also the absence of millions of tons of food that doesn't reach store shelves or dinner tables. With the number of American families experiencing food insecurity, this loss cannot be ignored.

Invasive pests pose unique challenges. When an invasive insect, disease or weed is introduced, the economic impact and ecological disruptions can be extreme. Recent insect examples include a fruit fly called the spotted wing drosophila, which is causing extensive damage to cherries, berries and other soft-sided fruit and a new invader called the spotted lanternfly that threatens grapes, hops and other crops and is spreading quickly from the Mid-Atlantic region. Diseases such as tar spot of corn are steadily spreading across the country, and a disease that sours citrus fruit, called HLB, has spread from Florida – where it's devastated the fresh citrus industry – across to California. Like COVID, HLB spreads from trees that are infected but asymptomatic, making it difficult to detect.

The full cost of invasive species damage in the United States is unknown. A 2004 study estimated the cost at $120 billion annually (Pimentel et al. 2005) and just the U.S. Department of the Interior spends $100 million every year on invasive species prevention, detection, management, research and habitat restoration (U.S. Fish and Wildlife Service. 2012). The U.S. Department of Agriculture's Animal and Plant Health Inspection Service is tasked with keeping damaging invasive species out of the United States but cannot stop every threat. Insect pests and plant diseases do arrive and very few can be successfully eradicated once they're established. Instead, they must be managed and the damage they cause minimized.

(For more about invasive species, see http://escop.info/wp-content/uploads/2017/05/NIPMCC_INVASIVES_FINAL_20210414.pdf.)

Integrated Pest Management is the Long-Term Solution to Pest Challenges

There's no silver bullet or magic dust to eliminate pests. The United States tried that approach in the years after World War II with broad-spectrum, persistent pesticides like DDT only to discover they caused significant environmental damage and their overuse quickly led pest species to develop resistance to the chemicals. (For more information about pest resistance, see http://escop.info/wp-content/uploads/2017/05/NIPMCC_RESISTANCE_FINAL_20210414.pdf.)

What works – and has been federal policy since 1977 – is an approach called integrated pest management, or IPM. IPM can be used in any setting where unwanted pests occur but was initially developed for and is most important in agriculture. The National Roadmap for Integrated Pest Management outlines this federal approach.

Integrated pest management is a scientific process and holistic approach to managing pests, based on their biology and the ecology of the farming system or setting. It seeks to avoid pests when possible and prevent pest populations from reaching economically damaging levels. IPM promotes natural, biological control of pest species, and the use of reduced-risk, selective pesticides when necessary. Both organic and conventional growers use an array of IPM practices to control pests and reduce risks to the environment and human health.

IPM is often practiced using what is called the PAMS approach: Prevention, Avoidance, Monitoring and Suppression. The graphic has examples of tactics in each of these areas, but there are many others. The power of integrated pest management is that it is adaptable to any arena and any pest-management challenge. IPM is an "all the above" answer for pest managers, allowing them to choose and combine all available tactics and technologies

Examples of IPM Tactics

Prevention: Keeping pests away from an area

- Using certified disease-free seeds or transplants
- Cleaning equiment between fields
- Netting, fencing and other exclusion activities

Avoidance: Keeping local pests from becoming a problem

- Chosing insect- or disease-resistant plant varieties
- Planting trap crops (or using phermone traps) to draw pests away from the main crop
- Rotating crops to prevent buildup of pest polulations

Monitoring: Knowing what pests and beneficials are around - and in what numbers

- Sweeping crops and accurately identifying insect populations
- Testing soils and monitoring weather
- Keeping records and tracking trends

Suppression: Reducing pest populations so they are not economically damaging

- Using cover crops and cultivation to manage weeds
- Encouraging or applying beneficial insects to control pest species
- Using selective, low-risk pesticides at the optimum time when economically necessary

that are safe and effective for their situation.

For example, when an organic grower plants a vegetable variety they can harvest before weeds produce seed, it's IPM. It's IPM when a grower uses mating disruption to keep pests from multiplying, or sprays a selective insecticide that preserves the beneficial insects in their fields so they can provide pollination or pest control services all season long. It's IPM when plants are certified as disease-free before being imported or planted, and when growers clean their equipment before moving between fields.

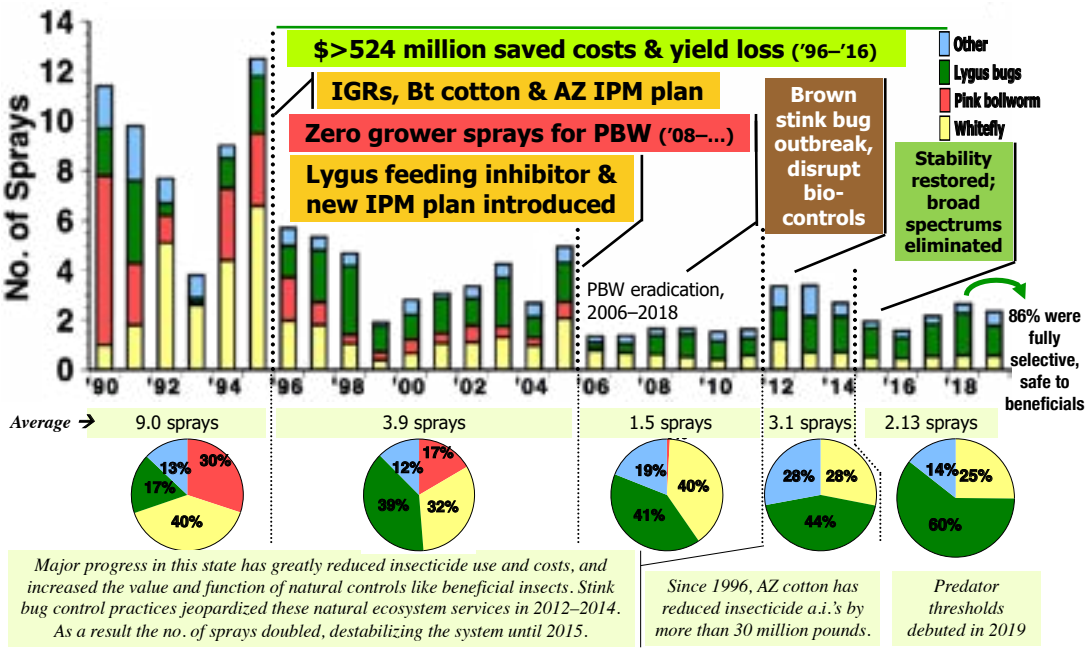
Environmentally, economically and socially, IPM pays dividends. One of the most comprehensive long-term studies has been of the cotton industry in the Southwest. There, growers were averaging 12 to 14 insecticide sprays each season in the early 1990s and today they're making two or three – and some none at all. The amount of insecticide growers applied dropped from more than four pounds of active insecticide ingredient per acre down to one or less today – and the insecticides today are selective and safer. Pest-control costs plummeted from a peak of $300 per acre to around $50 (Ellsworth, et al. 2020).

No one thing brought about these improvements. Instead, they were the cumulative result of many small improvements – new chemistries, new technologies and ongoing applied research and Cooperative Extension work to develop new scientific understanding of pest- and predator-insect relationships, and then train growers how to use these new IPM tactics and technologies.

That work is ongoing because the need is ongoing, in cotton and every cropping system. Conditions on the ground change as new pests are introduced or old pests resurge. Cropping systems and pest ranges shift as a result of climate change. Pests develop resistance to some pesticides, and others are taken off the market due to environmental or heath concerns. Even positive developments in agriculture necessitate ongoing pest-management research. Plant breeders developing new varieties of crops or engineers building new types field equipment can change the way growers need to manage pests.

Integrated pest management is the answer to America's pest challenges, but that answer is never fully finished. It is – and must always be – a work in progress.

Insecticide spray reductions in cotton brought about by IPM research and advances



IPM Reduces Risks to People and the Environment

Like public health programs, the key goal of integrated pest management programs is to reduce risks. IPM seeks to reduce the environmental, economic and human-health risks posed not only by pests, but also by pest-management practices. It's a balancing act that requires constant update and refinement.

Pesticides are a good example. To grow the amount and variety of crops American farmers produce, pesticides are necessary. But some of these chemicals can cause health problems for people or environmental damage. Because these effects are usually felt in rural areas and communities of color, this is an environmental and social justice issue.

IPM scientists work to create effective alternatives to these hazardous pesticides to protect the people applying them and the communities where they're used. Some of these solutions are better biological control solutions or changes to cultivation practices, and some can be more selective pesticides – for example a chemistry that regulates an insect's growth but does not affect people or other mammals.

IPM is the practical approach to pest management that ensures the economic vitality of rural communities, the safety of farmworkers, rural residents and consumers, and the availability of plentiful, fresh, affordable food for all Americans.

Integrated Pest Management Infrastructure, Funding and the Regional IPM Centers

There is no single agency or authority governing IPM in the United States. A Federal IPM Coordinating Committee coordinates IPM use by federal agencies, and the National IPM Coordinating Committee gathers input from states and regions to develop IPM research priorities and communicate those to federal officials. States have their own IPM programs and policies.

The U.S. Department of Agriculture's National Institute of Food and Agriculture is the major funder of IPM research in the United States. Because IPM is used in so many different arenas, integrated pest management research is supported through a variety of federal programs: Specialty Crop Research Initiative grants, Agriculture and Food Research Initiative grants, Organic Research and Extension Initiative grants and the Sustainable Agriculture program.

IPM is most directly supported through the federal Crop Protection and Pest Management grant program, although funding for this program has remained static for many years. The Crop Protection and Pest Management program supports three competitive grant competitions. One funds IPM research scientists to develop new IPM technologies, practices and strategies; a second supports state IPM programs to educate growers and other pest managers and increase their adoption of IPM; and the third funds coordination and communication through the Regional IPM Centers in the four regions of the country.

State IPM programs link research and end-user adoption of integrated pest management tactics in agriculture and urban areas. They translate university pest management research into practical steps people can use to manage pests, and then develop the educational tools necessary for people to learn and adopt the new methods. State IPM programs also link new or emerging pest problems with university researchers through a network of Cooperative Extension professionals and stakeholders. This two-way conduit – problem to research and research to solution – makes state IPM programs vital contributors to innovation for the future.

The Regional IPM Centers engage extension agents, researchers and others across multiple states to identify regional changes to pest pressures due to climate change, a new invasive or newly resistant pests. They develop regional priorities and communicate those to federal agencies and research universities, directing attention and funding to emerging problems. After the spotted lanternfly was detected in Pennsylvania, for instance, the Northeastern IPM Center quickly funded a group of regional researchers who are now leading the effort to develop ways to manage this pest. The Regional IPM Centers fund signature programs specific to their regions and collaborate on national-level efforts. Each Center also provides small competitive grants to fund the public scientists and community organizations doing important IPM research and extension in their areas. The Centers coordinate and communicate across state and regional borders to marshal resources and maximize efficiency.

A Wake-up Call

COVID was a wake-up call to the importance and fragility of American agriculture, but the development of vaccines within a single year is also an incredible testament of the power of directed science to solve important problems.

For the ever-changing multi-billion problem of pests, the collaborative science of integrated pest management is critical to protecting American agriculture from current and future threats posed by native and invasive insects, weeds and diseases. Support for the public research scientists and Cooperative Extension specialists that create and disseminate these IPM tools is vital because American agriculture is vital – and vulnerable.

References

Ellsworth, P.C., A. Fournier, G. Frisvold and Naranjo, S.E. (2017). Chronicling the Socio-economic Impact of Integrating Biological Control, Technology, and Knowledge over 25 years of IPM in Arizona. In Proc. 5th International Symposium on Biological Control of Arthropods, P.G. Mason, D.R. Gillespie, C. Vincent, eds. CABI, Langkawi, Malaysia. Sept. 11–15, 2017. pp. 214–216. http://www.isbca-2017.org/download/ISBCA-Proceedings.web.pdf

Mordor Intelligence. 2020. United States Crop Protection Chemicals Market - Growth, Trends, COVID-19 Impacts and Forecasts (2021-2026) https://www.mordorintelligence.com/industry-reports/united-states-crop-protection-pesticides-market

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics.* 52 (2005) 273 – 288. doi:10.1016/j.ecolecon.2004.10.002

USDA Economic Research Service. 2020. Ag and Food Sectors and the Economy. https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/

U.S. Fish and Wildlife Service. 2012. The Cost of Invasive Species. https://www.fws.gov/verobeach/PythonPDF/CostofInvasivesFactSheet.pdf

The National Integrated Pest Management Coordinating Committee is a committee of the Experiment Station Committee on Organization and Policy and the Extension Committee on Organization and Policy within the Association of Public and Land-grant Universities governing structure. It assists in development of reports and strategic plans on pest management issues and pursues activities that facilitate coordination and collaboration nationally among and between IPM research and extension at the land-grant universities, and between the land-grants and federal agencies involved in IPM.

Learn more: http://escop.info/committee/national-integrated-pest-management-coordinating-committee-nipmcc/