Organic Agriculture and Integrated Pest Management: Synergistic Partnership Needed to Improve the Sustainability of Agriculture and Food Systems

Executive Summary

One of the greatest challenges of the 21st century is the need to feed a growing population while improving the productive capacity of agricultural ecosystems, and the health and integrity of surrounding environments for future generations. Integrated Pest Management (IPM) and organic production methods can work together to address this vital challenge. While there are significant differences that need to be understood and respected, the two overlap, with much in common. Both fall far short of potential for adoption, bound by common constraints including inadequate public prioritization and investment.

Despite shared interests and tactics, few leaders and practitioners actively participate in both the IPM and organic communities, foregoing the synergies that could come from exchanging thoughts and ideas, and joint pursuit of common priorities.

Organic and IPM proponents and practitioners share a desire to achieve the benefits greater adoption can deliver. Shared interests include promoting and improving environmental quality, farm economic viability, social equity, and soil and human health. Organic is wholly compatible with advanced, biologically based IPM and most IPM principles and tactics will work in organic systems.

Despite common interests and tactics, few leaders and practitioners actively participate in both the IPM and organic communities, foregoing the synergies that could come from exchanging thoughts and ideas, and joint pursuit of common priorities. Our goals as authors include illuminating ways that organic and IPM can work together to spur further inquiry, discussion and action leading to increased adoption and growth in the benefits more sustainable production systems deliver.

Growing challenges

Human population continues to increase along with expectations for higher quality food and more resource-intensive production including animal agriculture. Many conventional farming practices are a leading source of pollution that threatens the sustainability of food systems and natural resources. Environmental and ecological consequences from current practices include pollution of ground and surface water with sediment, nutrients and pesticides; air pollution; declines in the health of critical pollinators and other beneficial organisms; loss of soil and carbon sequestered in soil; increases in greenhouse gasses; and declines in biodiversity. Losses from insect pests, diseases and weeds persist, along with increased frequency of pest resistance to commonly used pesticides. Yet many prioritize fast, cheap and easy approaches, and share a sentiment that traditional conventional systems are working, with no need to change. Too few research programs at public institutions focus first on understanding the problem and then developing sustainable solutions. Technology is promoted as the answer without addressing underlying fundamental systemic flaws. Public resources for research and education are declining while demands continue to increase for sustainable solutions.

Organic Agriculture and IPM

Both organic and IPM tactics require greater management skill to implement effectively than calendar-based application of inputs. According to a definition adopted by the International Federation of Organic Agriculture Movements in 2008, organic agriculture is "a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity, and cycles adapted to local conditions, limiting the use of inputs with potential adverse effects. Organic agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved."

Key benefits of organic agriculture

- Fewer adverse environmental impacts.
- Fewer pesticide residues on food products.
- Documented improvements in nutritional quality in dairy, some fruits and vegetables.

Key limitations

- Lower yields.
- Rigorous restrictions on pesticide and fertilizer inputs, which are nearly exclusively limited to substances derived from natural products.

Although IPM is a requirement in the National Organic Program and many other eco-labels, IPM is not a distinct production system. As defined in the USDA National IPM Roadmap, updated in in 2013, IPM is "a science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies. IPM coordinates the use of pest biology, environmental information, and available technology to prevent unacceptable levels of pest damage by the most economical means, while minimizing risk to people, property, resources, and the environment. IPM provides an effective strategy for managing pests in all arenas from developed agricultural, residential, and public lands to natural and wilderness areas. IPM provides an effective, all encompassing, low-risk approach to protect resources and people from pests."

Key benefits of IPM

- Reduces reliance on single tactics; improves resilience of production systems.
- Can reduce pesticide use, residues, pest damage, production costs and risks, and health and environmental impacts.
- "Big tent" of fundamental principles with flexibility to create new approaches, address any pest complex, and be implemented at different levels along a continuum and adapted to any production goals including organic.

Key limitations

- Benefits and ability to make claims in the marketplace are highly dependent on the extent to which available IPM tactics are adopted, and limited by lack of consumer understanding.

Commonalities and key differences

Organic and IPM researchers, educators and farmers have pioneered and been early adopters of less harmful approaches to pest management. Many organic farmers practiced IPM before transitioning to organic; and certified organic producers are required by the US Department of Agriculture (USDA) National Organic Program (NOP) to integrate IPM practices including cultural and biological controls. A number of practices relied on by organic farmers are becoming more common in conventional farming including cover crops and measurement/improvement of soil health metrics.

Organic benefits from broad consumer awareness and support, price premiums and a clear set of standards included in the NOP. Organic systems are designed to promote biodiversity and soil and plant health. Farm plans describe how the organic approach is to be implemented on each certified farm. When justified, reduced-risk pesticides, largely limited to naturally derived substances, can be used.

IPM is more narrowly focused on pests, and is not an agricultural production system like organic or conventional, but an approach to pest management that can be used in diverse situations and production systems where pests are a problem. IPM has been defined as "a decision-based process involving coordinated use of multiple tactics for optimizing the control of all classes of pests (insects, pathogens, weeds, vertebrates) in an ecologically and economically sound manner." Different classes of tactics, including chemical, cultural, host resistance and biological methods, are integrated in ways that usually allow production systems to move away from traditional, calendar-based pesticide applications to more ecologically sound strategies. When chemicals are applied, applications are guided using economic and treatment thresholds, based on monitoring and forecasting of pests and beneficial organisms, plant phenology and environmental conditions.

IPM is inherently designed to be applied differently depending on specific conditions including climate, location, weather, crop, pests and beneficial organisms. Eco-label programs that require IPM of participating growers typically specify requirements on a crop and region-specific basis, including prohibitions and restrictions on particular high-risk pesticides.

Approaches to weed management illustrate a difference in perspectives between organic and IPM researchers and educators. Although IPM recommendations include cultural, mechanical and biological practices that are also used by organic farmers, IPM research and education has not focused on reducing synthetic herbicide use as a top priority. To overcome glyphosate-resistant weeds—which for organic farmers are no more challenging than non-resistant weeds—much of the emphasis has been on alternative herbicides, not alternatives to herbicides.

Constraints to greater adoption

Organic and IPM research, development and outreach needs are increasing as demand grows for more production and fewer negative impacts. Yet badly needed systems approaches, which focus on resolving underlying problems, must compete for resources in both public and private sectors against patent and revenue-generating opportunities offered by input product and service development. At the same time, public investment in research and education is declining in real dollars and as a percent of total investment in relation to proprietary private sector research, development and marketing. Although biopesticide market growth is projected to continue to outstrip that of conventional pesticides for the next several years, the organic and advanced IPM input markets remain too small to attract investment in NOP-compliant or other reduced risk products on par with the conventional product market.

Many current public policies and market incentives discourage adoption of practices that may cost more in the short term, yet benefit the environment and agricultural sustainability in the long term. As a result, most farmers focus on maximizing yield and profit; they are not competitive in the marketplace if they unilaterally adopt practices that take into account environmental or social costs externalized by other farmers. Pesticides continue to be relatively easy to use, affordable, widely available and promoted, and employed by nearly all growers. Calendar-based pesticide application schedules require a simplified knowledge base compared to management-intensive organic and IPM approaches. Simplified strategies and externalized costs carry a high price including water pollution, water shortages, climate change and health risks to humans and ecosystems. Improving sustainability will require more than seeking the highest possible yield at the lowest possible cost.

Agriculture delivers many ecosystem services and has potential to deliver many more. If additional farmers are to provide more services to society in terms of soil, water and biodiversity, some form of compensation will be needed as an incentive. Organic and IPM growers must compete with conventional farms' subsidies and externalities that discourage the adoption of more sustainable practices. Policies to internalize these external costs would help encourage the adoption of more sustainable practices.

While market premiums provide incentives for transition and cover at least a portion of the costs of lower organic yields, demand outstrips supply in many organic crops. U.S farmers are missing important market opportunities, and more research and education is needed to overcome yield deficits compared to conventional production. Barriers to increasing organic supply include complexity and costs of organic certification, real and perceived challenges associated with transition to organic, peer pressure, ideological opposition, lack of research and demonstrations, inadequate technical assistance and serious pest management challenges that limit yield and quality under organic restrictions.

Multiple food company quality assurance programs and eco-label certifications require participants to implement IPM tactics. While the term IPM has gained recognition among many wholesale buyers, it is not recognized by retail consumers, and measuring and communicating environmental and health benefits of IPM are in part limited by the lack of a uniform definition of IPM analogous to the NOP standards. Thus IPM is not the leading claim in supply chain programs including those at Sysco, McDonalds, Costco or others, or in eco-labels including the NOP, Eco Apple, Food Alliance, Rainforest Alliance and Forest Stewardship Council. Price premiums in programs other than the NOP are rare to non-existent, negating an opportunity to support reduced-risk tactics that may be more expensive. These programs provide other economic benefits to participating producers including customer retention, and access to new customers and markets.

Common priorities

IPM and organic proponents and practitioners have similar needs for increased resources for research, technology transfer, education, outreach, and public policy and private-sector incentives. Both are interested in reducing production costs and increasing financial incentives for good environmental stewardship. Institutional and individual changes at the implementation and policy levels can encourage sustainable agriculture practices that benefit growers using IPM and organic methods, including a recognition of the similarities and synergies that can result from greater collaboration.

Both communities face unsustainably high farmer retirement rates in the near term, and need new farmer recruitment and education programs. The greatest need is capacity to develop a new generation of

researchers and Extension professionals who understand the theory and practice of both IPM and organic agriculture to serve the practical needs of producers and improve sustainability. This is a tremendous challenge during a time of retrenchment in public investment in public and science education.

In addition, all growers need solutions to pest management problems including weeds; diseases such as fire blight of apples and pears, and late blight in tomatoes and potatoes; and newly introduced pests, such as spotted wing drosophila, brown marmorated stink bug and Asian citrus psyllid which spreads the devastating citrus greening disease. Organic growers in particular need NOP-compliant solutions. Low impact solutions, including systems, cultural and biological approaches that are not amenable to intellectual property rights and proprietary revenues, need to be prioritized and incentivized.

Recommendations for action thresholds, or pest population or damage levels at which it makes economic sense to intervene, need to consider variable crop value so they can be readily adjusted by growers to reflect the often higher value of organic crops or the limitations of pesticides allowed for organic production, including earlier application timing or more frequent applications. They need to incorporate abundance of, or potential to introduce, beneficial organisms, which are often key tactics in organic and advanced IPM approaches.

Recommendations

The authors share a common vision of a world where organic and IPM proponents and practitioners work together to improve farm viability, public health and the environment. While we acknowledge differences in production practices, and regulatory and market conditions, those differences allow for fertile common ground. A growing number of consumers and taxpayers are becoming more aware of, and exercising influence over how food and fiber is being produced. Together we can leverage this market and public interest to advance knowledge, science and technology; communicate with one another our successes and failures; combine efforts through mutual understanding of strategies, plans and projects; and effectively evaluate and report needs and progress to farmers, consumers, taxpayers, researchers, educators, policymakers and regulators.

The collaboration between organic and IPM must become a public-private partnership recognizing the need and opportunity for policy and market forces to work together to address these challenges and achieve our goals.

In addition to pest management, by working together and with others, we can also more effectively improve outcomes associated with energy, irrigation and nutrient use for livestock, crops and other plants, which are inextricably tied to air and water quality, and soil, plant, animal and environmental health.

Our key recommendations include:

- Increase public and private support for long-term, interdisciplinary systems research that provides working models and field-scale demonstrations of both organic and advanced IPM systems that farmers, researchers and practitioners can use.
- Facilitate adoption of sustainable practices through publicly funded programs that expand outreach, promote collaboration between IPM and organic proponents, and compensate farmers for ecosystem services provided.
- Eliminate publicly funded programs that encourage unsustainable practices based on maximizing yield and profits at the expense of environmental quality and health.

- Increase public incentives, including pesticide registration improvements for product and service providers to develop, formulate, market and sell more options that are compatible with organic and advanced IPM systems, including biologically based pesticides.

The authors strongly recommend and request that organic and IPM communities commit to work together to achieve these common goals. While organic and IPM share many goals, their needs are not identical but complimentary in many instances. Organic has succeeded largely within the marketplace through consumer choice and marketing efforts, but needs help with transitioning producers to meet the market demand. IPM has a broader acceptance in governmental policy and in conventional farming, but has struggled with creating adequate economic incentives for adoption especially in large-acreage commodity crops. The collaboration between organic and IPM must become a public-private partnership recognizing the need and opportunity for policy and market forces to work together to address these challenges and achieve our goals.

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