Integrated pest management

Advances in sustainable food production and food security

Integrated pest management (IPM) is an old concept that is based on environmentally safe pest management practices. This is set to change with the development of a revised model of integrated pest management. The new model aims to balance three important factors – economic viability, environmental safety and social acceptability – in achieving sustainable food production and food security. It is already having an impact around the world and has the potential to redefine IPM for the 21st century.

Strawberry growers in Moldova.

IPM is a versatile philosophy capable of guiding practitioners facing varied situations.

Despite its advantages, integrated pest management (IPM) has not been well understood or widely adopted as an approach for sustainable agriculture. The development of a revised model that redefines IPM for the 21st century and incorporates all factors that influence sustainable crop production is set to change this. Not only does it promote IPM-based crop production that is more accessible, reflects current global food production and consumption trends, it also considers environmental safety as well as socioeconomic conditions.

The new model has encouraged IPM educators and implementors to revise teaching material for students and crop production guidelines for farmers, and to develop new agricultural strategies. Recently published article in the *Journal of Integrated Pest Management*, it had a record number of views and downloads.

An online IPM survey had 122 responses from the US, Argentina, Brazil, Canada, Chile, China, Croatia, Czech Republic, Indonesia, Kenya, Nigeria, Pakistan, Turkey, Uganda and other African, Asian, European and Central American countries from growers, pest control or crop advisors, private researchers, agricultural partners and university faculty and researchers.

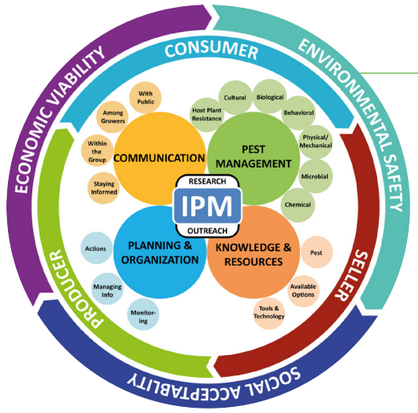
Of these responses, nearly 96% indicated that they had applied or would apply the new IPM-based information on their farms. Now, outreach information provided to those surveyed seems set to be adopted on around 955,000 acres with an estimated $33.6 million improvement in farm income or savings.

Through several outreach events and professional conferences, this new IPM model has been delivered to several researchers, extension educators, students, and IPM practitioners in California and other parts of the US. It has also been successfully taught to fruit, vegetable, and ornamental farmers in Guatemala, Moldova, Mozambique, Myanmar and other places. Several educators have revised their IPM trainings and crop or pest advisors have developed new programmes based on the new model. Researchers in Croatia have also released new IPM guidelines based on this model.

Evidently, the new IPM model has potential to improve the efficiency of pest management, optimise associated costs and increase farm profitability. The hope is that its advantages will continue to be realised internationally.

A HOLISTIC APPROACH TO IPM

Early models of IPM focused on ecological aspects of pest management. The revised model expands IPM to include management, business and sustainability aspects, and emphasises research and outreach. It views IPM as a versatile philosophy capable of guiding practitioners facing varied situations. It provides a universally applicable template with the flexibility to choose the components that are appropriate for the local environmental and socioeconomic conditions. The new IPM model is also designed to: re-evaluate what is perceived as sustainable; increase consumer-confidence in IPM-based production; enable profitability for producers while allowing informed



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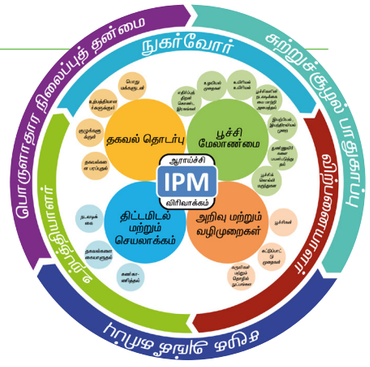

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by providing refuges or avoiding practices that harm them. Release of irradiated, sterile insects is another effective technique. Pest behaviour can also be exploited for monitoring or controlling them through baits, traps and mating disruption techniques.

Physical or mechanical control covers techniques for pest exclusion, trapping, removal or destruction. Microbial control refers to the use of bacteria, fungi, nematodes or viruses, and fermentation

endemic or invasive pests and diseases and for some seed treatments. Some chemicals derived from microbes and plants have many of the same human and environmental safety risks as synthetic pesticides.

Safer pesticides have been developed and some have become better regulated in recent years. Even so, poor agricultural practices or lack of IPM awareness contribute to chemical overuse and the associated risks of resistance in pests

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consumers to make appropriate food choices; and reduce the negative impact of non-IPM-based conventional practices and alternatives that have been assumed to be sustainable.

AN OVERVIEW OF IPM

For both environmental and economic reasons, managing pest populations to levels that do not cause economic losses works better than attempting to eradicating pests completely. Different pest management options are used at different stages of crop production to prevent, reduce or treat pest infestations. Together their effects can be helpful in reducing yield losses.

The categories of pest management that may be used are: host plant resistance, cultural control, biological control, behavioural control, physical or mechanical control, microbial control and chemical control. Host plant resistance (the use of cultivars that resist or tolerate pest damage and so reduce yield losses) is the first line of defence in IPM.

Cultural control involves adopting agronomic practices that avoid or reduce pest infestations and damage such as: clean seeds/plants; best planting dates and densities; modified irrigation practices, fertilizer programmes and other agronomic practices to create conditions that are less suitable for pests; and sanitation practices such as removing infected/ infested plant material.

Biological control includes releases of commercially available natural enemies or conserving natural enemy populations

byproducts of some microbes, against arthropod pests, plant parasitic nematodes and plant pathogens.

Chemical control typically means the use of synthetic chemical pesticides but several biopesticides also contain chemical molecules of plant or microbial origin. While these should be a last resort, they are needed for some and environmental contamination. In countries where pesticides are not regulated, they remain a health hazard for both growers and consumers. In addition to botanical and microbial materials, the biopesticide category now includes ribonucleic acid interference (RNAi) technology where double-stranded RNA is applied to silence specific genes in the target insect. Some biostimulants based

German German. Translated by Johannes Jehle & Silke Dachbrodt-Saaydeh, Julius Kühn-Institut.

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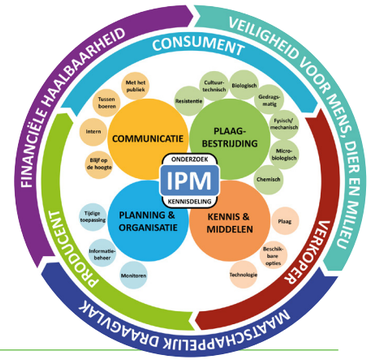

Portuguese (Brazilian)

Portuguese (Brazilian).Translated by Humberto Silva, British American Tobacco.

Spanish (Guatemalan)

Spanish (Guatemalan). Translated by Otto Rivera, Partners of the Americas Farmer to Farmer Program.

on minerals, microbes, plant extracts, seaweed or algae that are used as soil amendments can induce systemic crop resistance to pests, diseases and abiotic stressors and offer additional benefits in crop protection.

EFFECTIVE IPM IMPLEMENTATION

All the pest management options described earlier need careful and appropriate application. Crop production is both precise due to modern technologies and variable as a result of the many biotic and abiotic factors and the proprietary practices of different farming operations. Consequently, information management and decision-making are equally critical for successful IPM.

To make a decision suited to a situation, the grower must be aware of the various management options, understand pest biology and damage potential and be able to assess available resources. Not all control options work against every pest. And not all options will be available in a particular place or for a particular crop, or be affordable.

Growers in the US and many other countries (especially developing countries and low-income growers in developed countries) report IPM implementation is limited by lack of knowledge and resources or economic benefit. Even in California, surveys found that rotating pesticides is commonly perceived as IPM, although this form of management is only a small part of IPM.

Monitoring of pests, record-keeping, timely corrective actions and keeping up to date about endemic and invasive pests, emerging threats and new control strategies are all part of IPM. Education of farm crew (who might be the first to spot problems) and communication among growers (pests do not observe boundaries) ensure that on-the-ground knowledge is shared.

The sustainability aspect included in the new IPM model covers economic viability, environmental safety and social acceptability. In an ideal world, food would be safe and affordable for everyone, and growers and sellers could profit from food production with minimal risk to the environment. In practice, balancing the needs of consumers, growers and sellers is challenging.

Consumers don't understand the various food production systems, including the safety of food items. Growers face pest problems and other challenges in trying to produce high-quality food economically. Sellers tend to market organic food at a higher price as an assumed safer alternative to conventionally produced food.

A system based on Dara's IPM philosophy and focused on sustainability can be safe, profitable and practical.

IPM COMPARED TO ORGANIC FARMING

Organic food production is generally perceived as safe and sustainable but this is not necessarily so. Some pesticides used in organic systems are as harmful to humans and other organisms as some chemical pesticides; or might need multiple applications to be effective. Pests develop resistance to biopesticides just as they develop resistance to chemical pesticides.

Organic farming practices might encourage natural enemy populations (biological control) but this does not always successfully suppress pests warranting excessive biopesticide applications and associated costs. Mechanical pest control practices such as vacuuming or tilling involve fossil fuel consumption. Inadequate pest control not only leads to crop losses but can result in pests spreading and make their control even more difficult.

Several strawberry and vegetable growers in California report that they produce organically to meet the market demand but would prefer to adopt IPM-based methods, where they can use non-organic options if needed. Similarly, growers in Bangladesh, Haiti, Moldova and Myanmar struggle with pest management but grow organically for the promise of high returns. There have also been several cases of adulterating organic pesticides with synthetic pesticides or unreported use of synthetic pesticides on organic farms.

High-cost organic food production can eventually lead to social inequality. Meanwhile, food security is increasingly needed for a growing world population. These findings suggest that, compared to organic farming or conventional farming with a non-ecocentric approach, a system based on the philosophy of the new IPM model that focus on sustainability can be safe, profitable and practical.

Consumer education about food production and the environmental implications of their food choices also an important part of IPM, which the old model is lacking. With research and outreach at the core, four components of the management aspect offering various parts of the IPM influenced by the influencing business and sustainability aspects, the new IPM model offers a comprehensive and universally adoptable approach for sustainable crop production.

Behind the Research

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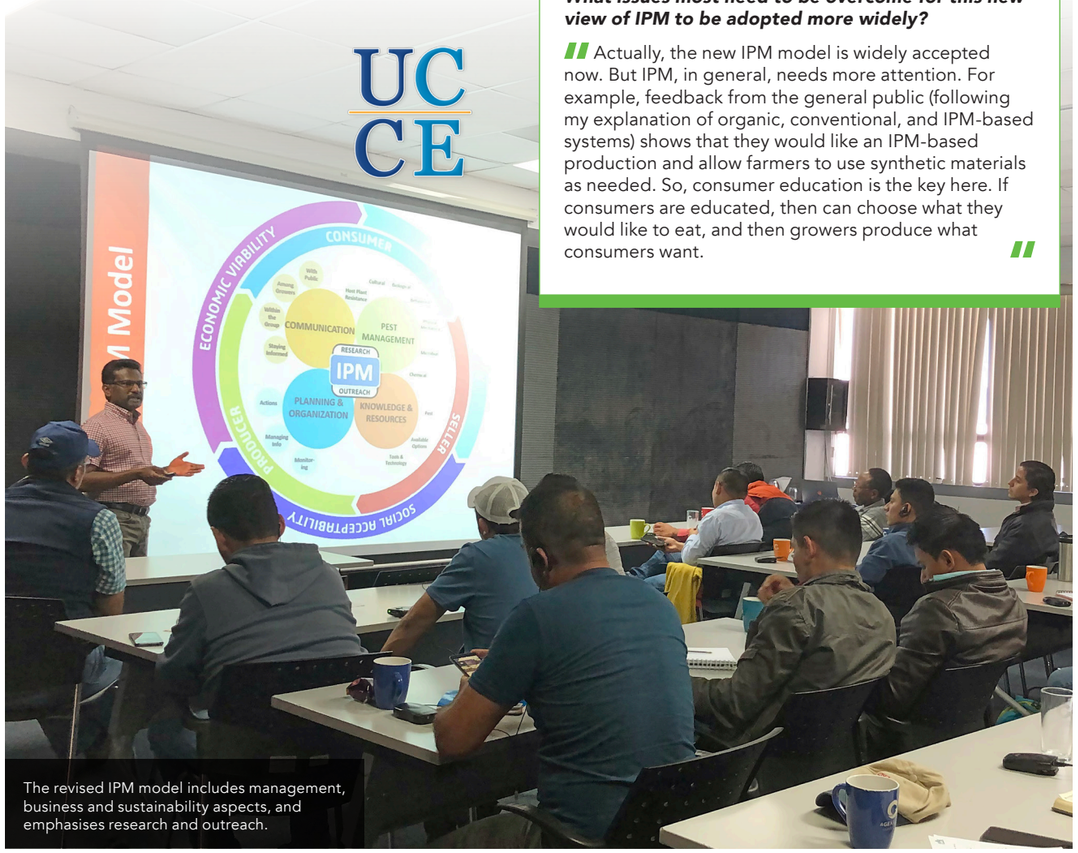
Research Objectives

As an IPM expert, Surendra K. Dara is developing sustainable production and pest management solutions in small fruits and vegetables.

Detail

Bio

Surendra K. Dara is an entomologist at the University of California Cooperative Extension with 25 years of experience in microbial control, IPM, and biologicals. His current research focus is developing sustainable production and pest management strategies in small fruits and vegetables. He has authored/co-authored nearly 370 scientific and extension articles.



The revised IPM model includes management, business and sustainability aspects, and emphasises research and outreach.

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Personal Response

What issues most need to be overcome for this new view of IPM to be adopted more widely?

"Actually, the new IPM model is widely accepted now. But IPM, in general, needs more attention. For example, feedback from the general public (following my explanation of organic, conventional, and IPM-based systems) shows that they would like an IPM-based production and allow farmers to use synthetic materials as needed. So, consumer education is the key here. If consumers are educated, then can choose what they would like to eat, and then growers produce what consumers want."

Ornamental growers in Guatemala.