Organic Farming: An Input to Reduction of Environmental Pollution

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Organic farming really a substantial and highly demanded portent now-a-days because of its beneficial nature for consumer and environment. To provide higher quality food/feed for increasing human population is a big task to developing countries. Insect-pests and diseases are challenge to whole farming community, organic or not. Losses from insect-pests, diseases and weeds persist, along with increased frequency of development of pest resistance to commonly used pesticides. It is estimated that the overall losses due to pests in India range from 20 to 32%. Even considering an average annual loss of production, the country is losing around 39 million tons of food grains and equal quantity of fruits and vegetables, which when added to the current production figures are targets of achievements by 2025. Therefore, crop protection assumes high significance in the overall food security of the country in the years to come.

In India several IPM/IDM modules have been developed. However, these modules need location specific validation on large scale. Crop protection is one of the major concerned in organic farming. Organic cultivation depends on a meager number of crop protection methods that provide only partial control of pests and can also entice lower yields and quality of products. However, IPM technology leftovers the paradigm in crop protection. Fundamental basis of its giving priority to bio-ecological processes and alternative techniques to reduce pesticide use. Earlier organic farming is mainly based on undefined methods of IPM, such as use of beneficial organisms, use of botanicals, encouraging ecology based beneficial bio-agents, mass insect trapping and behavioral modification of insects using pheromones, etc. Really, actual IPM use is only 7-8%, and in the immediate future it must reach respectable positon. Except cotton and some extent rice, the adoption of IPM in other crops is low to negligible. Greater management skill is required to effectively implement IPM than calendar-based application of inputs.

Organic agriculture: 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 (International Federation of Organic Agriculture Movements, 2008). However, considerations of benefits and limitations of organic agriculture are lesser adverse impacts on environmental and pesticide residues on food products. Improvements in nutritional quality in vegetables, some fruits and dairy. However, lower yields and restrictions on pesticides and fertilizer inputs, which are nearly exclusively limited to substances derived from natural products. IPM is a key component in support of organic farming. Increasing demand of organic product in present market is obviously one of the main factor, inspiring farmers to adopt organic farming.

IPM technology "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" (USDA NIFA, 2013). The IPM should by now the backbone of the entire crop protection umbrella, but still awaiting the due attention in field that it deserves.

An integrated decision support systems (IDSSs) for crop protection services need to be devised centrally to monitor the pest dynamics through e-surveillance, analyze pest risks, provide pest forecasts along with ICT-based dissemination of advisories keeping in view prevailing weather, and change in climate. The spread of pathogens and the severity of the diseases can be vary in space and time, rational and cost effective disease management requires the consideration of many factors. The number and complexity of these factors makes reaching a sound, rational decision for disease management also a difficult task. IDSSs are interactive computer-based systems that consider strategic decisions for pest control even under complex and uncertain conditions.

IDSSs help eliminate unnecessary use of pesticides by providing precise knowledge of the risk of an epidemic at field level. Therefore, farmers consider IDSSs one of the most valuable tool in IPM, with direct and concrete application in terms of pest control and a reduction in reliance on conventional pesticides (Rossi et al. 2012).

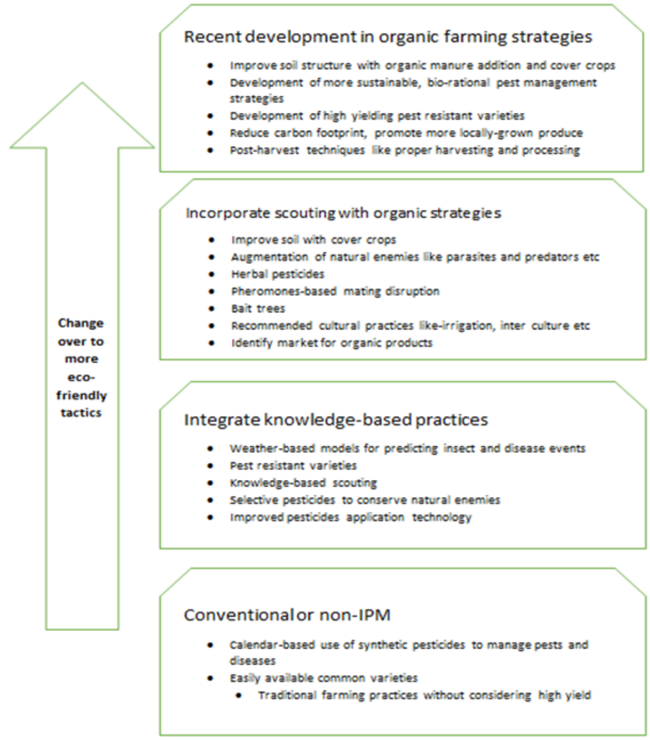
Main component of IPM tactics that can be combined for effective pest management.

1. **Biological:**
   Release of natural enemies (predators, parasites and parasitoids) and use of microbial bio-pesticides and bio-stimulants, botanicals, and seed bio-priming etc.
2. **Cultural:**
   Cover crops, rotation, mulching, intercropping, cultivar mixtures, false seedbed, selection of planting sites, trap crops, and adjusting the timing of planting or harvest.
3. **Genetic resistance:**
   Use of pest-resistant plant varieties bred through conventional and/or genetically modified methods.
4. **Mechanical:**
   Mechanical and robotic weeding.
5. **Physical:**
   Use of barriers, row covers or trenches, traps, sticky boards or tapes, vacuuming, mowing or tillage, and hand picking of pests, use of insect pheromones to trap and killing of pests, latest pesticide application technology.
6. **Dissemination of technological advancement:**
   Popularization of benefits of IPM technology including latest development in science.
7. **Chemical** (as a last alternative):
   Use of conventional pesticides only when indispensable to prevent severe yield losses.

Major benefits and limitation of IPM:

- Reduction of pesticide use, residues, yield loss, cost of cultivation, risks, health and environmental impacts.
- Improves resilience of production systems and lesser dependency on single tactics.
- A pergola of fundamental principles with flexibility to encounter or address any new pest complex and adapted to any organic production goals
- Lack of consumer understanding about organic product along with limited marketplace, which are highly dependent on the insurance of quality of organic product and the IPM tactics are adopted.

Development or substitution to more eco-friendly strategies for organic farming package



Constraints to adoption and demand of IPM:

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. Although bio-pesticide 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 other reduced risk products on par with the conventional product market.

Pesticide resistance evolution among pest populations is another important factor driving a need to reduce our reliance on conventional pesticides. During last decade, a large number of studies reported the evolution of resistance among various plant- pathogenic fungi/oomycetes to synthetic fungicide products, some of the fungal pathogen developed resistance to dozens of fungicide products (Table 1). All these examples suggest that there is a need for reduction and/or better use of resistance-prone, conventional pesticides in agriculture (Lamichhane, *et al.* 2016).

Table 1: A list of fungicide resistance evolution by plant-pathogenic fungi/oomycetes

Pathogen	Resistance	References
Alternaria solani	Boscalid , Penthiopyrad	Miles et al. 2013

Ascochyta rabiei	Pyraclostrobin	Delgado et al. 2012
Botrytis cinerea	Fenhexamid , Boscalid	De Miccolis Angelini et al. 2014
	Pyraclostrobin	Bardas et al. 2010
	Benomyl	Tanovic and Ivanovic 2010
	Benzimidazole, Dicarboximide	Banno et al. 2008
	Thiophanate-methyl, Iprodione, Fludioxonil	Fernandez-Ortuño et al. 2015
	Carbendazim, Diethofencarb, Procymidone, Pyrimethanil	Sun et al. 2010
Cercospora kikuchii	Thiophanate-methyl, Methyl Benzimidazole carbamate	Price et al. 2015
Cercospora sojina	Quinone outside inhibitor	Standish et al. 2015
Colletotrichum cereale	Azoxystrobin	Young et al. 2010
Fusarium spp.	Fludioxonil	Gachango et al. 2011
Fusarium graminearum	Carbendazim	Chen and Zhou 2009
Helminthosporium solani	Thiabendazole, Thiophanate-methyl	Geary et al. 2007
Monilinia fructicola	Propiconazole	Brannen et al. 2005
	Methyl benzimidazole carbamate	Chen et al. 2013
Penicillium digitatum	Fludioxonil	Kim, Saito, and Xiao 2015
Penicillium expansum	Pyrimethanil	Caiazzo, Kim, and Xiao 2014
Peronophythora litchii	Carboxylic acid amide	Wang et al. 2010
Phytophthora capsici	Mefenoxam	Cafe-Filho and Ristaino 2008
Phytophthora infestans	Mefenoxam	Childers et al. 2015
Sclerotinia homoeocarpa	Propiconazole, Thiophanate-methyl	Jo et al. 2008
Sclerotinia sclerotiorum	Dimethachlon	Ma et al. 2009
Venturia inaequalis	Kresoxim-methyl,thiophanate methyl	Chapman et al. 2011
	Benzimidazole	Quello et al. 2010

(Source: http://dx.doi.org/10.1094/PDIS-05-15-0574-FE)

Still farmers faces many challenges that require an understanding of the systemic nature of the problems, rather than simply responding to symptoms. Though, the area currently under organic farming is very limited it is evident that IPM has major role to play in organic farming and IPM research should include the development of strategies to support organic farming. Therefore, organic and IPM communities can work together to address these challenges for develop and increase adoption of solutions.

To do so efficiently and in a timely manner will require changes in policies and the marketplace. The key policies we recommend are:

- Promote 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.
- Acceleration in 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.
- Should be stop publicly funded programs that encourage unsustainable practices focused on maximizing yield and profits only.
- Identify and create groups for product and service providers with incentives to formulate, market and sell more options that are compatible with organic and advanced IPM systems, including biologically based pesticides.

These above points needs further work to develop them as viable options. Changing attitudes of farmer towards the adoption of new agricultural practices is not easy, but ultimately, unless farmers and growers are prepared to use such technologies, most of them will never find their way into crop protection practice. Government should bring legislation to stop indiscriminate use of chemical pesticides and restrain the input dealers from misleading the striving poor millions of farmers who feed our nation and the globe. With policies conducive to promoting organic and IPM systems, together we can address the serious challenges we face to feed the world without destroying it. To enhance interest of farmers in IPM technology, it is also essential to invest in developing forewarning technologies for epidemiologically potential pests. Similarly, strengthening the surveillance mechanisms and educating the farmers through the transfer of technologies shall be of great help in adoption of IPM in future to increase area of organic farming and ensure food security.

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