Integrated Pest Management (IPM) for Sustainable Agriculture

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Integrated pest management (IPM) is not a new philosophy. The concept has been around since the 1920's when a cotton pest management program was developed. However, the development of inexpensive pesticides caused us to get on what is commonly referred to as the "Pesticide Treadmill". That is, because these new pesticides were extremely effective and inexpensive, we used them as the answer to all pest problems. The overuse of these pesticides causes specific problems like:

Insecticide resistance

Resistance to insecticide is a serious and growing problem in pest management. Worldwide, more than 600 species of pests have developed some level of pesticide resistance against different formulation of insecticides.

Secondary pest outbreak

By using a broad-spectrum insecticide to control a pest, it inadvertently kills beneficial insects which would normally keep another pest under the economic threshold. This "secondary" pest is then able to multiply rapidly and it then becomes a significant pest.

Biomagnification

Biomagnification, also known as bioamplification or biological magnification, is the increase in concentration of a substance, e.g a pesticide, in the tissues of organisms at successively higher levels in a food chain. Some pesticides started to bioaccumulate in nature. High levels could be found in fish, birds, and mammals (including humans). For example, DDT caused sharp population declines in predatory birds such as the bald eagle.

Insecticides are not the only solution for agricultural pest management. Although many ecofriendly methods are incorporated in to an IPM program.

There are so many definitions of IPM but according to FAO "Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."

IPM is a philosophy. That is, we recognize that there are no cure-alls and/or cheap and easy methods to manage pests. Reliance on a single tactic will favor pests that are resistant to that practice. For example, relying on single group of insecticides to manage the sucking pests can results in development of resistant pest species against that particular group of insecticides.

Identify and correct the cause of the pest problem

Instead IPM stresses reliance on preventative management practices and balances the strengths of one practice against the weaknesses of another to provide a more complete or holistic pest management approach. Rescue (should rescue treatments be defined, or is it apparent?) treatments are used only if the preventative practices fail. For example, a preventative practice might be planting a okra leafhopper resistant variety. Only when leafhopper populations are extremely high will an insecticide treatment may be required. Hopefully, by planting the leafhopper resistant variety you might not spray for leafhoppers during the season. Another example is that proper weed control may create an environment which insect to not find attractive. Therefore, by controlling weeds within your fields you may also avoid some insects.

The eradication of a pest is seldom necessary or even desirable, and is generally not even possible. IPM realizes that some pest damage is acceptable. We must focus on economics before implementing any management techniques. We should only initiate management techniques when the cost of

management is lesser than the amount of damage expected.

With IPM we can:

- Monitor pests to see when they are present and make sure control is cost-effective
- Trick and Avoid pests by planting or harvesting early or late
- Trick pests by using pheromones (attractant smells) to disrupt their mating or trap them
- Trap pests by planting attractive plants on the edge of the crop field—then destroy them
- Use special plants to attract parasites & predators to the crop field—so they kill pests
- Induce an 'immune response' in crop plants—so they repel or kill pests
- Apply special plant extracts, microbes and parasites—so they repel or kill pests

Pesticides vs IPM

IPM doesn't means that it can't include use of pesticides in management techniques. In some agro systems, they are a very important part. Some pests because of sheer numbers, continuous occurrence, low thresholds or because of food contamination issues dictate pesticide use. However, it can be used as a last resort, when all other management techniques, including preventative techniques, have failed or are no longer economical. Pesticides are to be used when there is no risk of environmental damage or when benefits outweigh the risks. Pesticides only used when other control practices aren't available or economical.

Monitoring of pest population

Prior to including any insecticides in pest management programme, fields must be monitored to make sure that:

- The pest is properly identified
- It is present in economical proportions, above the ETL (Economic threshold level)
- Is at a life stage that is susceptible to the pesticide
- Present at a crop stage when there is "preventable yield loss".

Generally, Pheromone trap, sweep net, square meter frame, water pan, Sticky trap, sphere trap, sieves and light traps are used for the monitoring of pest.

Important agronomic practices optimize growing conditions for the crop

- Deep summer ploughing to expose the hibernating pest in the soil and also increases the aeration in the soil.
- Application of fertilizers on the basis of recommendation that can give the crop a competitive edge over weeds
- Proper plant spacing (row to row and plant to plant) is also important. A dense crop canopy will shade the ground making emerged weeds less competitive and also preventing germination of more weeds and reduces weed seed production for subsequent years.
- Sowing/Planting time- Time of sowing/planting is very important. Early sowing of Indian mustard avoids attack of aphids.
- Selection of variety is necessary so that it can compete with the population of pest (germinate early and provide rapid early season growth).
- Use of trap crops to protect the main crop (In cotton trap cropping should be done with crops like okra, castor, marigold, *Nicotiana rustica* so the pest feeding on these, should be periodically removed or killed).
- Proper weeding and sanitation should be done, some pest prefer to lay eggs on grassy weeds, by removing these grassy weeds we can avoid problems of pest.

Natural control of pest to enhance the population of natural enemies

Natural enemies of insects play an important role in limiting the densities of potential pests. An example is to spray an insecticide for mustard aphid control only, when it is economically feasible and it is apparent that natural enemies will not control the aphids. Lady bird beetle and syrphid fly population was found in large number in mustard, in this case do not use insecticides to kill aphids. Once natural

enemies are removed from the field, the pest may increase at a much faster rate

Biological Control of pests

Biological Control refers to the introduction of a predator, parasite or pathogen (disease) to control a pest. One of the most significant successful examples of classical biological control is the, control of papaya mealy bug *Paracoccus marginatus* through the introduction and field releases of exotic natural enemies. The indigenous natural enemies like *Spalgis epius, Cryptolaemus montrouzieri* and *Scymnus coccivora* could not keep the papaya mealy bug population under check. Three species of exotic parasitoids, *Acerophagus papayae*, *Pseudleptomastix mexicana* and *Anagyrus loecki*, which were known to effectively suppress the papaya mealy bug in its native range, were imported from USDA-APHIS in Puerto Rico.

Major Obstacles in IPM

- Low awareness and innovativeness of extension personnel and target groups
- IPM requires a higher degree of management, Making the decision not to use pesticides on a routine or regular basis requires advanced planning and higher degree of management. This planning includes history of pest problems, selection of variety and other agronomic practices plan.
- Inadequate interaction between research and extension agencies
- Problem of timely and adequate supply of quality inputs, including Bio-control agents and biopesticides.
- Complexity of IPM *vs* simplicity of chemical pesticides
- The dominant influence of pesticide industry
- Non-availability of location-specific IPM modules for many crops
- IPM adoption is influenced by the cost versus efficacy of products, need for sophisticated information for decision making, ability to integrate new products and techniques into existing farm management practices and managerial skills.

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