



REVIEW ARTICLE

INTEGRATED PEST MANAGEMENT (IPM), BEST APPROACH TO CONTROL THE AGRICULTURALLY HARMFUL PEST POPULATION

Saugat Pandey, Samed Kumar Chaube*

Institute Of Agriculture Sciences, Banaras Hindu University, Varanasi, 221005, U.P, India
*Corresponding Author email: bivekkumarchaube122@gmail.com

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ABSTRACT

Green revolution has no doubt led to increased global food supplies, but at the same time it has introduced several ecological, environmental, and socio-economic problems. After green revolution, using of dwarf and semi dwarf high yielding varieties of crops, increased used of Agrochemicals and irrigation happened which resulted in increased intensity of several pest. To control these pests, we opted synthetic chemicals as best method, but it created a lot of health issues and killed beneficial insects too. Residual impact of chemical has shown hazardous impact. Now it's time to change by opting IPM practice i.e. Integrated Pest Management. IPM is not a new philosophy, the concept has been around 1920's when cotton pest management was developed.

KEYWORDS

socio-economic, synthetic chemicals, philosophy, pest management

1. WHAT IS IPM?

IPM is a comprehensive approach of integration on diverse method which are compatibles to each other, economical, environmentally sounds and sociologically acceptable to control pest population under the economic injury level (ETL). It accounts a various relevant control plan and method in coordinated pest management.

2. WHY IPM IMPORTANT?

IPM is important because it focus on dynamics process to promote the growth and developments of healthy crops with reduced possible interferences to agro ecological system (IPM Guidelines, 2009). It promotes for natural pest control mechanism by the use bio agents and bio fertilizers. It takes the benefits of all pest management strategies, including judicious use of pesticides for sustainable agriculture that accumulate adequate, safe and quality food production (AGP, 2012). Simultaneously, uplifts farmer's livelihood and conserve the non-recycled resources. Its basic goal is to prevent insect population from attaining economic injury level (EIL). Such goal aims to contribute food and water safety, by reducing the residues in food, feed, fibers and ecosystem balance. It is important to minimize the production cost through reduced level pesticides. Thus, commands higher market price and contributes in increasing the income of farmers.

3. STAGES IN CROPS PROTECTION LEADING TO IPM

Subsistence phase: At these phase, the level of plant protection which we achieved either due to inherent property of variety (resistance variety) or by agro climatic condition or by natural control (by nature). But no insecticide use.

Exploitation phase: After the discovery of insecticidal property of DDT (1939 poul millers) people thinks it is for all insect. So, applying more pesticides, growing of hybrid variety and get more yields returns. Due to such exploitation of DDT and BHC, insect develops the resistance against

it and many non target insect are killed.

Crisis phase: Due to over dose spray, problems of resurgence, rsistance, secondary pest outbreak and agriculture become non profitable.

Disaster phase: in 1983, application of insecticides more than 50%in cotton results Helicoverpa develops the resistance and total failure of cotton crops particularly Guntur and Parkashan district of India. More than 100 farmers committed suicide. In this phase due to over use of pesticide there are no profits, high soil residue- collapse of control system.

Integrated management phase: It integrates eco friendly and sustainable method to optimize pest population below economic injury level (ETL).

4. PRINCIPLES OF IPM

Prevention and suppression: It is a measure to prevent the buildup and occurrence of the pest. It can be done by hygiene measure i.e. by regular cleaning of machinery and equipment. It includes the range of practical strategic i.e. stale seed bed technique, under sowing, pruning, direct sowing etc. While suppression is the reducing the impact of pest on the crops. Crops rotation, plant selection, careful irrigation, sowing dates and densities of plant etc recommended in reduction of pest problems (Alastair, 2003).

Monitoring: Monitor crops for both pest and natural control mechanism can be done through observation, scientifically sound warning, forecasting and early diagnosis system etc. IPM often requires collaboration decision in relation to quarantine regulation and legislation facilities and training of advisory services and strategies to check the growth and outbreak of highly mobile pest (All, 2002). GPS, GIS and remote sensing technique can also be followed for management wide range of field area.

Identification: It is critical to distinguish the pest and beneficial insect to control the outbreak of disease and symptom. Superficially similar symptoms of pest, disease and environmental damaged can be observed. So, ground level identification of suspected pest species, plant condition,

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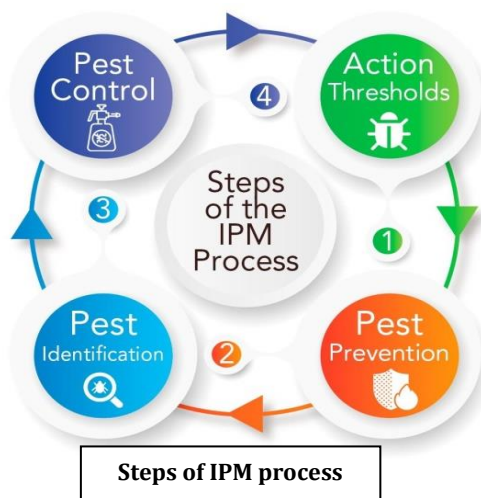
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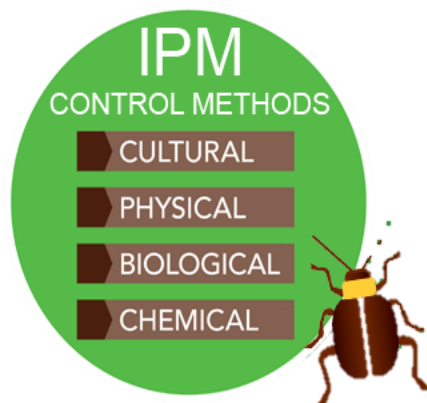
Utilization of economic threshold levels: It is a very relevant consideration to control the level of pest population at below the economic injury level (EIL). Economic threshold is the density of a pest at which control treatment will supplies economic returns. Determination of such threshold is crucial to the development of any pest management methodology.

Application of minimum selective hazard: Use of the chemical measure to pest population in such a way that target pest population is just kept under economic threshold level/economic injury level (Barfield and Swisher, 1994). Observation of this principle the growth of resistant population of pest is avoided or delay, the possibility of resurgence of treated population is reduced, is reduced quantity of environment infection is lowered.

Evaluation: It is a vital aspect of the IPM programs. It is carried out based on the records use of pesticide i.e. pesticide nature, selection, its effect, pre treatment data Vs post treatment data, treatment records (methods, dates times, rate, cost, etc.) Similarly, IPM program is evaluated in changing injury and action thresholds, visual inspection or numbering of the pest and non target organism before and after treatment. At last, it also evaluated feedback from clients or site users.



5. TOOLS OR COMPONENTS OF INTEGRATED PEST MANagements



5.1 Cultural Method or Use of Agronomic Practices

It is the prevention of injurious insect pest by adopting or changing different farm practices like ploughing, sowing, irrigation, harvesting etc. Such practice does not allow the favorable condition for life cycle, growth, and breeding of the pest. So, pest population reduced. Here, followings measure is adopted.

Selection of site /crops: It is crucial to select proper field and climatic region for successful production of crops. The selected site should free from pest and nematodes, good soil tilth, adequate supply of water and manures, proper sunlight area, large beneficial soil microbes, etc. Selected varieties should resistance to that particular climatic region. For example: *Mythima seperata* , *Spodoptera mauritia* and *S. litura* are found in all region but severe in flooded area.

Tillage operation: Deep ploughing of soil reveal hidden eggs, larvae, and pupa of insect, nematodes, parasites and rhizomes of weeds becomes the source of food for natural enemies. Tillage operation brings about unfavorable condition for multiplication of pest and disease, lifecycle and food chain, destroy the alternate host of pest. And suppress the population by mechanical damaged or buried deep in the soil.

Sanitation: Field sanitation used to reduce pest infestation through the destruction of breeding and hibernating site. It involves the cleaning of seed material, FYM and manures, eradication of harmful weed host, timely destruction of crops residue removal of shelter of pest etc to minimize the pest population build up.

Time of planting and crops duration: Adjustment in time of sowing or transplanting is resorted to agronomic practices to minimize crops loss. For examples: Gram sown before 15TH of October reveals less infestation of *Heliothis*. Rice may lesser suffer from bore infestation if transplanting early June.

Destruction of volunteer plant: Volunteer plants are off type plants of new variety such type are impure and more susceptible to pest which grows along the standard variety. Unless they are destroyed they help on continue a pest population by furnishing a food source to a long life cycled pest of preceding crops. Examples: Potato tubers which remained in soil during harvesting germinate early and attract potato cutworm.

Manures and fertilizer: Plant nutrition can influence the feeding, growth, survival, and fecundity of phytophagous pests. Use of excessive concentration of nitrogen increase susceptibility of crop to sucking type of pest (mites and aphids) and leaf eating pest. On other hand, K₂O and P₂O₅ addition reduce incidence of certain pest. Example: Wireworm population tends to increase in the low P₂O₅ soil. So balanced application of NPK should be recommended to tolerate pest and disease.

Crop rotation: Rotation of crops with non host crops is effective against pest that have limited host range, fecundity period and that cannot survive for more than 1 or 2 seasons without suitable host. Example: Infestation of steam borer of rice may be reduced by cutting jute after rice. Most of rotation includes legumes, roots crops and grasses.

Thinning, topping and pruning: Removal of unhealthy and infected plants is called thinning which is vital to control insect pest population. Example: Infestation of green hopper in rice can be lowered by thinning of rice plants. Topping is the cutting or mowing the aerial parts of crops to prevent pest infestation (Olkowski et al., 1991). Example: topping of cotton remove the eggs of *Heliothis*. Pruning is the judicious removal of unhealthy, diseased and dead portion that greatly reduce the overwintering stage of pest population. Example: Leaf minor red scale of citrus, apple aphid and peach leaf curl can be controlled through pruning.

Management of traps crops: Traps crops (susceptible nature) are used to divert the polyphagous insects attack away from the main crops field. Example: Lady's finger is grows around the cotton field to control the jassid and spotted bollworm.

Water management: Apply the flood irrigation most of the sub-terrestrial soil inhibiting pest like cutworm, termites, white ants, sugarcane white grubs etc are exposed to natural enemies and some flown away. So, pest infestation and population is reduced.

5.2 Mechanical and Physical Method

Such method involves the management and control of pest by using physical components of environment or use of labours with or without aid of equipment. The vital components are as follows:-

Destroying after handpicking: Use of human hand to pick up the various stages of pest via. Eggs, larvae, pupa, insect itself periodically and are destroyed. It is the oldest method and is suitable for adults and egg mass of rice stem borer, lemon butterfly, early larval stage of jute hairy caterpillars etc can be picked by hand and destroyed.

Use of hand net or screen/barriers: Insect pest like green leaf hopper, grasshopper, bugs, flies etc can be collected and destroyed with hand nets. Screen net is used to cover the nursery seedlings like brinjal, chilly, tomato, fruits and cereals plant etc to protect from the transmission of virus by the harmful insect (*Bemisia tabaci* and many other).

Use of mechanical traps: It consist of various traps as describe below

- **Light traps:** It is used to attract and kills the nocturnal insect pest. Example: white grubs, rice steam borer, leaf hopper, moth, etc.

- Air suction traps: It is used against stored grain pest.
- Greases band traps: Used to control mango mealy bug, wingless insect and ants.
- Electric traps: Used on birds and wing insect.

Temperature: Insect activity and metabolic rates are influenced in increase and decreased environmental temperature. Example: Low lethal temperature cold storage of potato checks the potato tuber moth. But, higher temperature is more effective to control the pest than lower temperature. Stem sterilization of glass ware kills the soil inhibiting pest (harmful insect, nematodes etc) and other harmful microorganism (virus fungus and bacteria).

Sound production: Sound energy acoustic device (acetylene exploder, firecracker) produce the certain loud sound which scaring birds, insect attacking to fruits and grain crops. Such device scatters away rats, squirrel, mosquito etc.

Burning: With the help of flame torches, locusts can be killed by burning.

Use of Radiant energy: Use of Gamma radiation or chemo sterilants, male insect sterile where such male insect released in normal population of insect to compete with the fertile males for copulation with females. Thus insect pest population can be controlled. High frequency radio waves which is used to kills hibernating pest like weevils and flour beetles with 15-20 second.

5.3 Biological Control Measures

Biological control is the use of natural enemies to minimize the damage caused by the pest population. Parasitoid, predators, pathogens and competitors used as natural enemies.

Parasitoids: It includes the organism which lay eggs in or on the body of their host and completes their lifecycle. Parasitoids are of different types i.e. egg, larval, pupal, adults, egg-larval and larval-pupal depending upon host developmental stage. It is vital in insect-pest management due to high multiplication rates. Bracon hebetor is ectoparasitoids against insect-pest of coconut and sugarcane. Trichogramma as a eggs parasite species is effective against pod borer, rice stem borer, cabbage diamond back moth etc.

Predators: Predators are free living organism who hunts or kills other organism for foods. It can be purchased and released in greenhouse to destroy certain pest. For examples:

- Lady bugs beetles eat aphids and mealy bugs.
- Mites as effective control of thrips.
- Beetles are freed to attacks whitefly larvae and adults.
- Spiders and mantids feed on several number and types of insects especially in rice field.
- Chrysoperla sp cause damage on variety of the soft bodied insects such as aphids, jassids, scale bugs leaf hoppers etc.

Microbial organism: These are the microorganism which infest and cause disease in their host as result host are killed. It includes: -

Virus: Nuclear polyhedroses viruses (NPV): Effective against lepidopteran insects in different crops. They cause typical "tree top disease" in insect pest. The infected larvae of insect initially turns white and granular, stops feeding become restless, reaches the top portion of the plant due to reduced O₂ concentration and hang from upper leaves or stem. Ha NPV and SI NPV is utilized for the management of Helicoverpa armigera and Spodoptera litura respectively.

Grnulosis viruses (GV) and Cytoplasmic viruses (CPV): Widely used against insect-pests of sugarcane.

EntomoPathogenic viruses: Highly specific to host insects. So, it makes them safe to non target organisms and environment. Mostly they are pathogenic to arthropods like insect, mites and parasitic arachnids.

Bactria and fungi:

Bacillus thuringiensis: Highly effective Gram-positive soil bacterium used against several insect-pests of order Lepidoptera. BT releases the toxin which damages the mid gut causes disease as a result insect turns black colour and die.

Metarhizium anisopliae, Beauveria bassiana and Verticillium lecanii are the entomopathogenic fungi act as a biocontrol agent is effective against gram pod borer, tobacco caterpillar and sucking pests like thrips, aphids and mealy bugs. Mode of action: Fungi cause infection when fungal spores germinate, insect cuticle degenerate through enzymatic degradation. Once get inside the body, the fungi multiply, invades the insect tissue causes the death of the insect.

Nematodes and Protozoa:

- *Heterorhabditi* sp and *Steimernema* sp: These nematodes harbor certain bacteria which act as toxins to insect pest system.
- *Variomorpha* sp: Effective against insect pests and incorporated as tools in organic farming.

5.4 Chemical Control Methods

It is the use of chemical pesticides to control the pest and disease. This method is often applied when it is necessary. Physically and biologically selected pesticide is desirable to reduce the potential injury to the human and environment. The main objective in selecting pesticide is that the selected must be harmless and non injurious to the non-targeted fauna and flora.

Chemical controls include pesticides derived from plants, such as botanicals, or other naturally occurring materials. It may be:

Botanical pesticides: Obtained from the natural plants material that is toxic to pest.

Horticultural oils: When sprayed on the insect causing suffocation by clogging their breathing pores.

Insecticidal soaps: Breakdown the protective layers of pest, bringing to death.

Extract of Neem seed kernel: Effective against rice cutworms, diamond black moth, rice brown plant hoppers, tomato hornworms, corn earworm, whiteflies green leaf hoppers, tobacco caterpillars.

generation with the symptoms of cotton leaf curl virus disease.

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