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Introduction of Integrated Pest Management and its Concepts

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I N T R O D U C T I O N

Integrated approach for insect control, which is now accepted as best strategy, has been defined by Stern et al., (1959) as "the utilization of all suitable techniques and methods, in as compatible manner as possible to maintain the pest population at levels below those causing economic injury". The more recent and complete definition given by FAO Panel of Experts on Integrated Pest Control (1967) is "a pest management system that in the context of associated environment and population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economic injury".

Interest in integrated pest management system has been stimulated by difficulties brought on by the almost total reliance on synthetic organic insecticides without regard to the complexities of the ecosystem, especially the fundamental aspects of the population dynamics of pest species and growing health hazards, has led to better knowledge of basic shortcomings of insecticidal control approach.

Moreover, single factor approaches for the control of insects are often inadequate through examples of dramatic control can often be cited for insecticides, pathogens, parasite, predators release of sterile males or resistant varieties. The term "integrate" was first used by Bartlett (1956) and the idea of "managing" insect pest populations was proposed by Geier and Clark (1961). Geier (1970) used "pest management" in preference to "Integrated control".

The concept of integrated control was originally mooted to bring about compromise between chemical control and biological control but the situation has changed and the scope of integrated pest control has widened to embrace not only chemical and biological control but also other means of control to keep the pest populations below economic injury level (Smith and Reynolds 1956).

In today's perspective the integrated pest management is the intelligent selection and use of pest control tools which will lead to favourable economic, ecological and sociological consequences (Apple and Smith, 1976; Franze 1960; Watson et al., 1965 Geier, 1966; Rabb and Guthrie, 1970 and FAO Panel of Experts, 1966 to 1972).

Principles and Strategies

- Monitoring insect pests and natural enemies
- Concepts and injury levels
- Integration of tactics

Relationship between Different Components

Prophylactic Measures

- Natural control
- Varietal resistance
- Cultural control
- Pest surveillance
- Forecasting and decision making

Curative Measures

- Microbial control
- Mechanical control
- Chemical control
- Inundation, augmentation of natural enemies

Essential Requirements for IPM

- Life history and behaviour of the pest
- Proper identification of insect pest
- Natural regulating factors
- Need for control measures
- Selection of suitable control measures
- Timing of control measures
- Farmers participation
- Government support

The concept of integrated control through in theory appears to be simple but in practice there are many problems in formulating such schedules.

Integrated pest management is a phased system and involves following steps:

To develop an integrated control programme against any pest, it is essential to determine possible effective methods for its control.

To establish economic threshold and economic injury level at which the control operations should be initiated.

The concept of economic threshold as the major criterion for formulating any pest management programme so far has been essentially ignored (Stern, 1973; vanden Bosch and Stern, 1962; Hoyt and Burts, 1974). The concept, which was first described by Stern et al., (1959) as the density at which control measures should be initiated to prevent an increasing pest population from reaching the economic injury level, is not so simple, particularly in view of recent models put forwarded by Hillebrandt (1960); Headley (1972); Hall and Norgaard (1973). Headley (1972) stated that economic threshold is that population level where the marginal benefit from damage prevented by control programme is equal to marginal cost of realizing that population, through a control programme. The basic elements as proposed in his model are:

- a pest population growth function
- a pest damage function
- a yield function
- a pest control function

Hall and Norgaard (1973) indicated that Headley's model is a static one and gives no information on optimal timing of application of control measures during the season. They showed that the economic threshold varies over time and under certain assumptions, increase with time, so that the closer the harvest time, the higher is the level of pest population that will be tolerated before controls are applied. They suggested following elements in their model:

- a pest population growth function
- a pest population kill function
- a pest population damage function
- a product yield function
- a pesticide cost function

As the economic injury level may vary from area to area, season to season, crop to crop, stage of the crop or with man's changing scale of economic values; the concept of economic threshold will also undergo a change. Thus it can be said that this concept is still in the process of evolution.

To bring about synthesis of possible effective control methods in such a way that the integrated components should hold the pests below economic injury levels and avoids disruption of systems from their chaos.

It is necessary before taking up an integrated pest management programme against any pest in a given agro-ecosystem to have basic information on its abundance and distribution, biological and behavioural characteristics, type of food, natural enemies and effective control methods. This knowledge will help in determining the vulnerable stages of pest, the appropriate time of action and the suitable effective method which can be used at particular time, for particular stage.

The tools and techniques of pest management programme as listed by Luckman and Metcalf (1975).

Cultural Methods

- Use of resistant varieties of domestic plant
- Crop rotation
- Crop refuse destruction
- Tillage of soil
- Variation in time of planting and harvesting
- Pruning or thinning
- Fertilization
- Sanitation
- Water management
- Planting of trap crop

Mechanical Method

- Hand destruction of different life stages of insects
- Exclusion by screens and barriers
- Trapping with suction devices and collecting machines
- Crushing and grinding

Physical Method

- Utilization of heat
- Cold
- Humidity
- Sound
- Energy in the form of light traps, light regulations and irradiation

Biological Method

- Protection and encouragement of natural enemies
- Conservation of natural enemies
- Introduction, artificial increase and colonization of specific parasitoids and predators
- Propagation, dissemination and use of specific bacteria, virus, fungus and protozoan diseases

Chemical Method

- Insecticides
- Attractants
- Repellents
- Sterilants
- Growth inhibitors

Genetic Method

- Propagation and release of sterile individuals of pests or genetically incompatible of pests
- Genetically engineered crop plants

Regulatory or Legislative Methods

- Plant quarantine
- Suppression and eradication programmes

Integrated pest management which is now a universally accepted concept has relevance to Indian Agriculture where modern production and protection practices have not been fully introduced to a large extent in most of the crops except few like wheat and rice and the average farmer cannot afford costly inputs like insecticides. Brader (1978) is of the view that future development in agriculture production will depend largely on integrated pest management system.

Advantage of IPM as Compared to Chemical Pesticides-Based Plant Protection Programme

- Economics
- Health
- Sustainability
- Environment quality
- Local knowledge
- Export of agricultural commodities
- Social and political stability

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