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ANALYSIS OF INTEGRATED PEST MANAGEMENT IN AGRICULTURE

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Abstract
Since humans first began raising plants and animals for food, pests have been a constant problem. Farmers have tried a variety of approaches to dealing with these pests throughout the years, with varied degrees of success. Commercial insecticides, on the other hand, revolutionized pest control in the 20th century. Pesticides of the 21st century have significantly reduced agricultural and livestock losses. One of its primary functions is to help farmers maximize their profits while simultaneously enhancing human health and environmental conditions. Due to recent advancements in agricultural technology, modern communication means, shifting consumer trends, growing awareness of sustainably produced food systems, as well as worldwide trade and travel, the IPM paradigm has become necessary in today's times. Host-plant resistance, natural plant products, biopesticides, natural enemies, and agronomic practices are all key components of integrated pest management (IPM) research. Crop cultivars with resistance to key insect pests and illnesses are also being developed using modern biotechnological technologies, such as marker assisted selection, genetic editing, and broad hybridization.

Keywords: IPM, Pest, Integrated, Crop, Productivity

Introduction

There is nothing new about IPM. A cotton pest management programme was devised in the 1920s, and the idea has been around ever since. Insecticides were applied in accordance with findings from regular assessments of pest and natural-enemy populations, which were "super-vised" by entomologists. [1] As an alternative to calendar-based pesticide treatments, this was seen as viable. Supervised management relies on a thorough understanding of ecology and forecasts of pest and natural enemy populations. An integrated approach (integrated control) aims to find the most effective combination of chemical and biological controls for a certain insect problem. For the sake of biological control, chemical pesticides are employed sparingly. Only when regular monitoring indicates that a pest population has exceeded an eco-nomic threshold level chemical controls are deployed. Consequently, this treatment is necessary to prevent the population from

reaching an economic harm threshold where the costs of artificial control measures would outweigh the economic losses. [2]

A method to increase crop production is known as IPM and it is influenced by a wide range of factors, including environmental and social ones. To produce crops, minimize losses, and maximize profits, each grower uses a unique method that is acceptable to the store, safe for consumers, and less harmful to the environment. [3] In other words, IPM is a method to pest management that is both cost-effective and environmentally friendly. Since crop production and protection, communications, as well as globalization of trade have advanced recently, a new IPM paradigm (Figure 1) is provided, which focuses on the following goals in the areas of operations/business management as well as sustainability: [4]

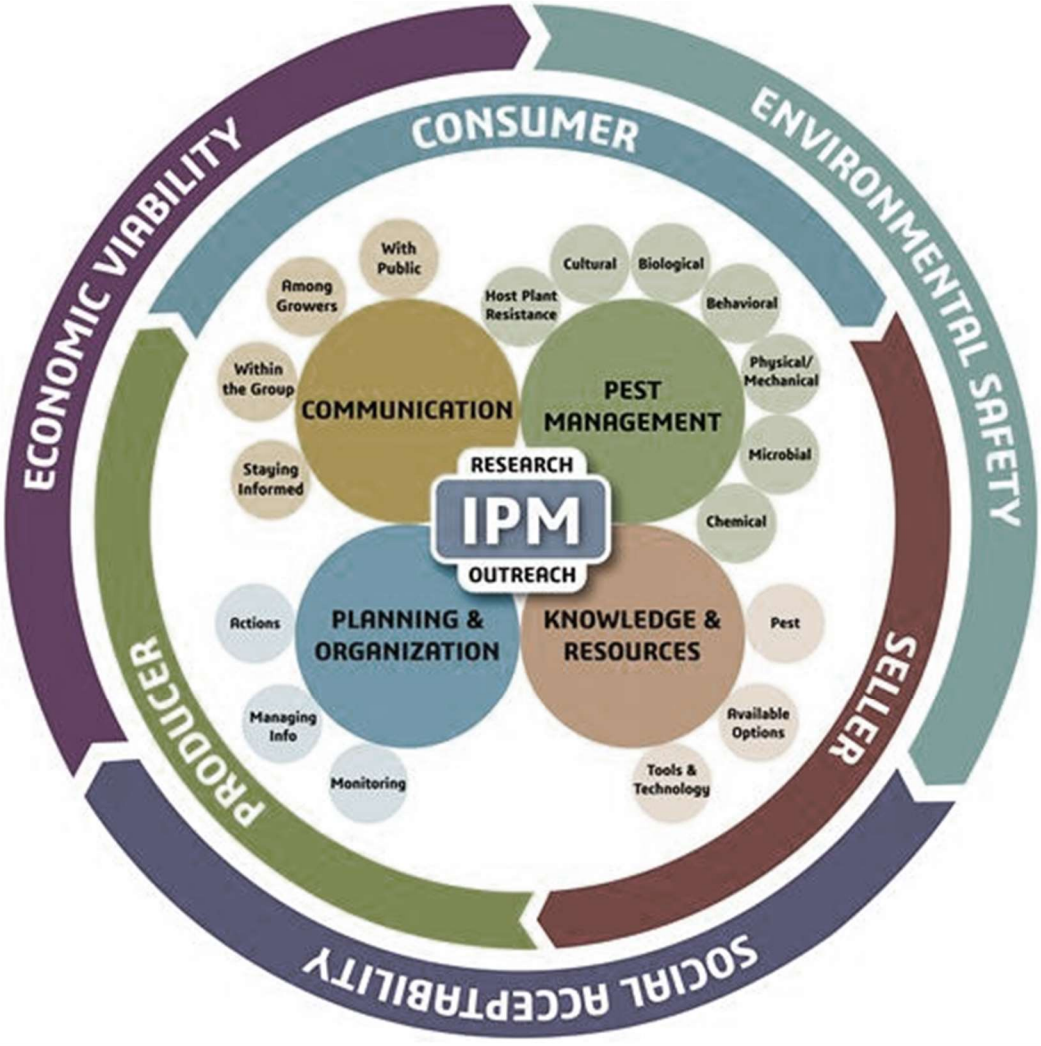

Fig. 1 New IPM paradigm with its various components and influencing factors for economically viable, socially acceptable, and environmentally safe pest management.

Incorporating insecticides and herbicides into a pest management system could be a broad-based ecological approach to structural and agricultural pest control. As an additional component of integrated pest management, IPM aims to keep an eye out for signs of infestation and intervene

(without using poisons) as necessary. Finally, IPM refers to the methodical selection and implementation of pest management measures with an eye toward minimizing negative impacts on the environment, human health, and social well-being. [5]

Benefits of an IPM programme

Farming and society gain greatly from the use of Integrated Pest Management.

a. Integrated Pest Management (IPM) preserves the environment by reducing pesticide use. Pesticides are only used in IPM if all other attempts at pest control have failed. In addition, they are utilized to reduce a pest organism to tolerable levels while minimizing environmental impact. [6]
b. IPM raises the bottom line. Profitability for the grower or farmer and it is ensured by the IPM program's use of the most cost-effective pest management strategies.
c. The risk of crop loss due to pests is reduced. To reduce crop losses or damage from pests, pest control and monitoring measures should be used.
d. Long-term social benefits of IPM would also emerge in the areas of employment, public health, and the well-being of those involved with farming. [7]

Disadvantages of an IPM programme

- Higher levels of management are required for an IPM programme. Avoiding pesticides on a regular or recurring basis needs more forethought and, as a result, more management. Crop varieties that are resistant or tolerant to pest damage are chosen, as are tillage practices that minimize pest damage while providing the best yield potential. This planning also takes into account past pest problems in the field.
- Integrated pest Management (IPM) might be more time consuming. Field scouting that is reliable, need to be conducted timely and accurately with grate practice. This data, on the other hand, is vital to IPM programmes and is their foundation. There is no way to make an informed management decision without this information. [8]
- The weather can play a role in success planning can be complicated by the weather. As an example, you could lessen the amount of herbicide used and cultivate the rows to reduce weeds. Row cultivation, on the other hand, may become ineffective if the soil is saturated for an extended period of time. Good IPM planners will therefore have a backup strategy in place before these issues arise [9].

Review of Literature

There has been widespread use of integrated pest management (IPM), a long-term approach to pest control, for a long time. Many definitions of IPM exist, however prior models focused more on the ecological and evolutionary elements of pest management than others (Peterson et al. 2018). [10]

IPM strategy developers, promoters, and practitioners all have different ideas on what IPM means. For example, according to the United States Department of Agriculture-Agricultural Research Service (USDA-ARS 2018) [11], Sustainable, scientific decision-making is at the heart of IPM, which uses a variety of tools and techniques from a variety of fields to help identify pests, control

their impact, limit health and environmental hazards, as well as reduce financial and cultural costs. A number of additional definitions emphasize on reducing or eliminating the reliance on chemical control choices, and embracing a variety of other solutions with the emphasis on environmental and human health, as well.

Some plant diseases can be exacerbated by either too much (Mitchell et al. 2003) [12] or too little nitrogen (Snoeijers et al. 2000) [13] in the plant. The pest's soil-inhabiting stages can be controlled by destroying crop leftovers and cultivating thoroughly. In order to keep pests from spreading, it's critical to follow good sanitation procedures, such as removing infected/infested plant material and washing field equipment on a regular basis.

Protecting and encouraging natural predators of pest insects is an important goal in the field of IPM (Naranjo et al., 2015) [14]. Successful application of IPM requires a thorough understanding of pest insects and their interactions with their prey. An important part of integrated pest management (IPM) is taking advantage of predator-prey interactions. Even if the processes used in organic food production are identical, pesticides derived from "non-natural" or synthetic sources are prohibited (US-EPA, 2014) [15]. As a key ingredient in the production of a plentiful and affordable food supply, chemical pesticides are used all over the world (US-EPA, 2015) [16]. Many environmental consequences have occurred despite an increase in food production due to the chronic abuse of chemical pesticides, such as the spread of secondary pests and the loss of beneficial insects. (Arora et al, 2014) [17]. As a result, farmers must continue their research and development of ecologically friendly pest-management practices in order for them to be successful (Pretty and Bharucha, 2015) [18].

In principle, IPM may be defined as a flexible and holistic system. This views the agroecosystem as an interrelated whole, that utilizes a variety of biological, cultural, genetic, physical, and chemical techniques that hold pests below economically damaging levels with a minimum disruption to the cropping ecosystem and the surrounding environment (Malena,1994) [19].

Objectives

- To study IPM, its advantages and disadvantages.
- To study effect of IPM in crop production in agricultural
- To study pesticide and its controlled use
- To overview different integrated methods to protect the crop

Research Methodology

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only the research methods/techniques but also the methodology. In order to apply the analytical and descriptive methods to the research a close reading and detailed analysis of secondary sources available. It is significant to get other perceptions to elaborate the textual analysis and this would need close reading analysis of few secondary materials.

Result and Discussion

IPM can be conceptualized as a system that is both adaptable and comprehensive. Pests are kept under control by using a wide range of strategies including biological, cultural, genetic, physical, and chemical methods that minimize the impact on the cropping ecosystem and the surrounding environment (Malena, 1994) [19]. Using this new model, IPM strategies around the world can create and implement sustainable agricultural practices to assure profitability for growers and affordable food prices for the world's expanding population. [20]

	Industrial and Green Revolution	**Present IPM (systemic adjustments)**	**Sustainable Agriculture (structural changes)**
Goal	Eliminate or reduce pest species	Reduce costs of production	Multiple economic, ecological and social goals
Target	Single pest	Several pests around a crop and their predators	Fauna and flora of a cultivated area and linkages with non-cultivated ecologies
Signal for Intervention	Calendar date or presence of pest	Economic Threshold	Multiple criteria
Principal method	Pesticide	Prevention by plant breeding and crop timing, careful monitoring, product substitution, insecticide resistance management and multiple interventions	Agroecosystem design to minimize pest outbreaks and mixed strategies including group action on an area-wide basis to complement pest controls aimed at individual households

Diversity	Low	Low to medium	High
Spatial scale	Single farm	Single farm or small region defined by pest	Bio-geographic regions
Time scale	Immediate	Single Season	Long-term steady-state oscillatory dynamics
Boundary Conditions	Everything as is: crops, cropping system, land tenure, microeconomic decision rules, social organisation	Major crops, land tenure, and decision rules. Economy treated as given but subject to some intervention via price supports and subsidies	
Research goal	Improved pesticides	More kinds of interventions	Minimize need for intervention
Research mode	Transfer of Technology (TOT)	TOT Mode	Complementarity between TOT and Farmer First Mode (FF)

Table 1. Approaches to pest management

If a rising pest population threatens to cause economic harm, control measures must be implemented at a density known as the economic threshold level (ETL). Site-specific factors, such as site structure and how the site is being used, will influence the ATL level that is required for human health, economic or aesthetic reasons (Fig 2) [21]

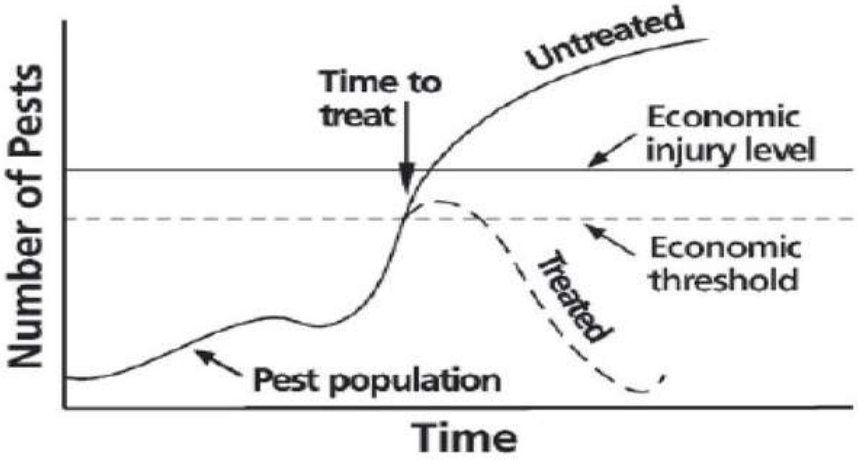

Fig. 2To make control practice profitable, or at least break even, it is necessary to set the economic threshold (ET) below the economic injury level (EIL). Graphic: National Pesticide Applicator Certification Core Manual, NASDARF.

Figure 3 presents an ideal situation of integrated protection in an apple orchard. This theoretical range of integration has rarely been tested in the field. In reality, IPM has often been a juxtaposition of different crop protection techniques [22]

Fig. 3 Integrating different methods to achieve pome fruit protection against pests, diseases, and weeds (adapted from Simon et al. (2017a) [23]

Conclusion

As a result of this scientific approach, earlier IPM models were developed to mitigate or prevent economic losses by considering ecological, environmental, and evolutionary elements of pest management. It is possible that the earlier models had insufficient scope to encompass all of the components of the whole equation that are necessary for effective promotion and implementation of IPM.

To maintain its dominance in the future, IPM can better utilize modern technology and traditional farming systems based on indigenous practices. Overall, IPM handles all economic, environmental, and social factors and delivers safe and inexpensive food to customers, as well as profits for producers and sellers, while preserving environmental health.

Food production relies on a wide range of people from agricultural academics and educators to sociologists and economists to managers and producers to pest management professionals to agricultural input manufacturers to retailers and customers. The new IPM model provides a framework for focusing on different parts of the paradigm and encouraging collaboration between other disciplines by rearranging the components and integrating numerous elements that influence them. Using this new model, IPM strategies around the world can create and implement sustainable agricultural practices to assure profitability for growers and affordable food prices for the world's expanding population.

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