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ORIGINAL PAPER

Importance of Economic Levels in Integrated Pest Management

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ABSTRACT

As the scope and opportunity of integrated pest management is increasing in India, the sound knowledge and importance of economic levels are becoming one of the most important parts towards maintaining sustainability, economic stability and production of viable management practices. These concepts should be known to farmers, scientists, researchers, extension workers to procure an absolute advantage after implementation of integrated pest management. The judicious application of pesticides in the field to protect our mother nature from contamination of harmful elements needs a balance between well timed management schedule and tolerable crop damage which cannot be possible without economic decision levels. Although there is a need for further research on this topic, especially devising the idea when multiple pests attack, the concepts of economic thresholds are important both for theoretical and field application.

Keywords- Integrated pest management, Concepts of economic levels, Importance for implementation at field level, Sustainability and Scope of research.

INTRODUCTION

Integrated pest management is a dynamic and constantly evolving approach to crop protection in which all the suitable management tactics, available surveillance and forecasting information are utilized to develop a holistic management strategy towards a sustainable crop production ahead. The word sustainability is quite important here as without economic benefits, a model can not be sustainable for all. In this regard, choice of application of

management strategies plays a dominant role for which precise identification of economic thresholds is the most Important thing.

CONCEPTS OF ECONOMIC LEVELS

In 1934, W.D. Pierce asked a very valid question to the world. That was "Is all insect attack to be computed as assessable damage? If not, at what point does it become assessable? Is control work warranted when damage is below that point?" The answer of his question came in 1959, when V.M. Stern and colleagues formally proposed the concepts and terminology of bio-economics that we use today. Specifically, they developed the ideas of economic damage, economic-injury level and economic threshold collectively called the economic injury level concepts. These ideas are given below-

Injury: Effect of pest or insect activities on host physiology.

Damage: Measurable loss of host utility in terms of quantity and quality.

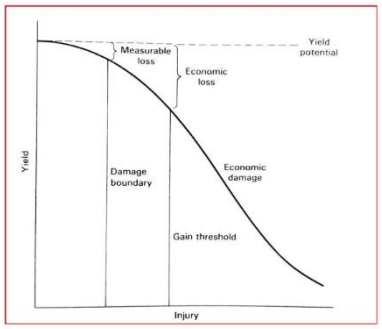
So, injury is centred to pest, and damage is related to crop and its response to injury.

Yield potential: It is the yield when non-limiting factors and stresses, i.e., pests, diseases, weeds, etc. are effectively controlled.

Damage boundary: Lowest level of injury where damage can be measured.

Economic damage: Amount of injury that will justify the cost of artificial/external control measures. (the loss that can be done by potential/actual pests exceeds the cost of control).

Gain threshold (Kg/acre): [Cost of management (Rs/acre) / Market value of the crop (Rs/Kg)]. Say, gain threshold is 5 Kg/acre, that means an insecticide application would need to save at least 5 Kg/acre for the activity to be profitable. So, it is the measure of marketable product per unit area.

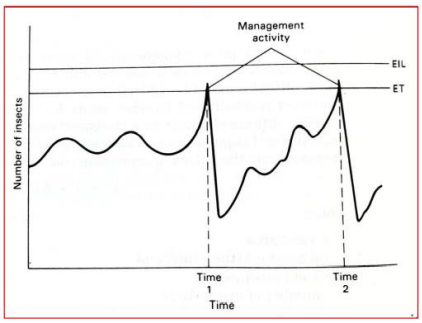


Graph showing relationships between the damage boundary and gain threshold

Economic Injury Level: It is the lowest number of insect population that cause economic damage or reduce the yield to gain threshold. Number of insects is an index of injury, because the amount of photosynthate loss is impossible to measure. So, if 1 insect/plant causes 1 Kg/acre loss, then EIL will be 5 insects/plant.

Economic Threshold Level: It is the maximum number of insect population that can be allowed to prevent any economic loss. Number of insects that triggers the starting point of management option, also called as action threshold. Actually it is a time parameter, but expressed as a number. It is always based on EIL value and less than it .

1. **Fixed ETL:** If EIL is 5 insects/plant, we can set ETL at 75% of EIL, i.e., 4 insects/plant .
2. **Descriptive ETL:** Calculated by Dutoit's formula as [ETL = EIL x C^{-x}], where C = factor of increase per unit time (say C = 0.5/weak, it means the infestation is increasing 50% per week), x = time period in question (say 5 weeks)



Graph showing the relationship between the economic threshold and the economic injury level in taking action against an insect population

IMPORTANCE OF THESE CONCEPTS

1. **Importance to farmers-** Farmers use a lot of money to manage the pests. But without the knowledge of the thresholds, it will only reduce the benefits of application. If they use under ETL, it is uneconomical as well as problematic for ecosystem. Uneconomical in the sense, the potential pests may be managed by the natural enemies or others, also there may be no need for application. Ecosystem is also damaged as the pests as well as their feeders are faced death due to untimely application of pesticides. Now, if they use above EIL, there is always a chance that the increasing population of pests may reach an explosive number, resulting in heavy economic loss. So better to use these managements at ETL, to get a time to equip with necessary requirements to stop the increasing population to reach the EIL. This timely application confirms the highest economic benefit to farmers with highest tolerable loss to maintain ecological harmony.
2. **Importance to researchers**- Researchers can use these concepts for making ETL levels for different pests. After minutely taking the data from sampling processes and assessing the cost vs damage relationship, ETL is determined which can be again used in field level.
3. **Selection of most suitable management strategy-**An appropriate management strategy can only be advisable if the cost of the application, efficiency and time requirement for effectiveness are known. Economic level concepts help to produce the most effective model for sustainable and suitable management strategies.
4. **Maintaining ecological balance-** As discussed above, economic concepts are very important for protecting ecological harmony. In fact, one of the most important parts of

IPM is protecting the balance of nature, which is corelated with judicious application of pesticides. These concepts give the knowledge to use pesticides only when needed, which increases the chance to reduce pesticide application, which ultimately aids in maintaining ecological harmony.

Ultimate implementation categories in field level

The place and ultimate use of ETs in pest management programs become clearer when their state of development is categorized. Accordingly, most of the decision rules currently used can be placed in one of the four categories –

1. No thresholds.
2. Nominal thresholds.
3. Simple thresholds.
4. Comprehensive thresholds.

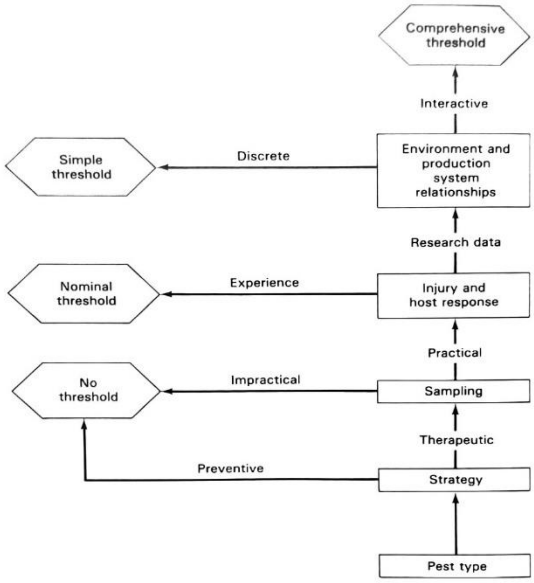


Diagram of the implementation categories of economic thresholds

Future research scopes

1. Introducing new ideas of economic action levels for vectors, medical and veterinary pests, forest pests where conventional ETL concepts are not valid.
2. Research on suitable economic concept in case of attack of multiple pests on a single crop at the same stage.
3. Research on introducing a rigorous definition of economic damage in term of its mathematical components.

CONCLUSION

The economic action concept has been one of the most important innovations in the development of insect pest technology and is the only truly unifying principle of pest management. Although not without drawbacks, EIL. decision rules are the most widely accepted and practical tools for their purpose. However, these decision rules are yet to be established for many species and need refinement in others. Refinement of the EIL concept for agriculture is possible in the form of environmental EILs and comprehensive thresholds, which account for multiple pests as well as other environmental stresses. Future development of environmental EILs will depend on our capability to quantify and include environmental costs in calculations, develop tolerant plant and animal varieties, and discover environmentally responsible management tactics. Future development of comprehensive thresholds needs to be founded on the total production system of a given agricultural enterprise. In large part, advancements here will depend on our ability to understand how diverse pests stress plants and animals and on quantification and detection of these stresses.

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