Role of Crop Modelling in Insect Pest Management

Balwant Yadav[1]* and Avinash Pal[2]

[1]*Department of Entomology, Banda University of Agriculture and Technology, Banda, U.P. – 210001*
[2]*Department of Horticulture, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur, U.P. - 233009*

Corresponding Author
Balwant Yadav
Email: balwant2001yadav@gmail.com

OPEN ACCESS

Keywords

Crop modelling, Agricultural entomology, Matrix model, Phenology model

How to cite this article:

Yadav, B. and Pal, A. 2025. Role of Crop Modelling in Insect Pest Management. *Vigyan Varta* 6 (1): 76-79.

ABSTRACT

Crop modelling offers a powerful framework for unravelling the intricacies of insect pest behaviour. By integrating scientific insights with practical applications, we can foster resilient agricultural systems that thrive in harmony with nature. Advanced insect pest modelling plays a pivotal role in optimizing crop protection strategies for sustainable agriculture. Advanced insect pest modelling plays a pivotal role in optimizing crop protection strategies for sustainable agriculture. By leveraging innovative technologies and predictive analytics, we can enhance Resilience against pest threats and safeguard global food security. Increase the efficiency of agricultural research and management and improve efficiency and environmental quality.

INTRODUCTION

Crop modelling in entomology involves using mathematical and computational techniques to stimulate and predict the interactions between crops and insects. The crop model offers a very promising way to estimate the reference level and its variability in the field (Dalal and Singh, 2017). This field plays a crucial role in understanding and managing insects' impact on agricultural systems, aiding in the development of effective pest management strategies.

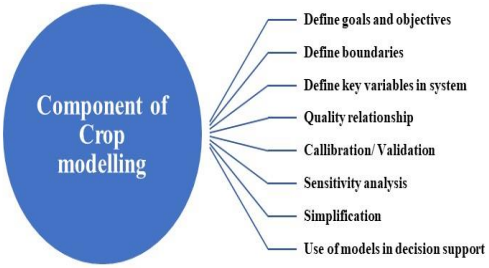
Need of crop modelling in agricultural entomology

Farmers face the difficult task of managing their crops during severe pest infestations. Scientists and research managers need tools to assist them in taking an integrated approach to finding solutions to the complex problem of insect pest management. Policymakers and administrators need simple tools to assist them in policy management (Dhaliwal *et al.*, 2005).

Importance of crop modelling in entomological research

- ✓ **Understanding Pest Behaviour:** Crop modelling helps in predicting and understanding pest behaviour in agricultural ecosystems.
- ✓ **Improved Pest Management:** Crop modelling helps in developing effective pest management strategies to protect crops from insect damage.
- ✓ **Economic Impact Assessment:** Contributes to the assessment of the economic impacts of insect pests on crop production.
- ✓ **Ecosystem Sustainability:** Supports sustainability by minimizing environmental impacts of pest control of pest control measures.
- ✓ **Precision Pest Management:** Enables precise pest management strategies reducing the use of harmful chemical pesticides.

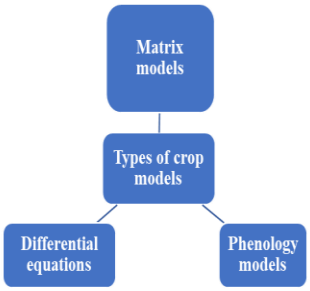
Key components of Crop modelling



TYPES OF CROP MODELS USED IN ENTOMOLOGY

According to Reynolds *et al.*, 2018, the crop models are classified based on uses,

1. For predicting population dynamics in the presence of multiple factors and how biotic and abiotic factors affect the interaction between pests and their natural enemies. The models are categorized into three parts.



Matrix Models

Crop Matrix works as a partner with the farmers to help them select the right agricultural Inputs like Seed, Fertilizer, Pesticides, Fungicides, Herbicides etc. based on Agro-climatic conditions of the geography.

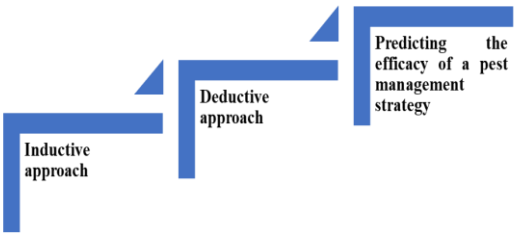
Phenology Models

The study of Phenology helps to understand the influence of weather dynamics on vegetative and reproductive growth periods. It helps in adopting better crop management practices such as pruning, water and nutrient management, and better-integrated pest and disease management (Messousi *et al.*, 2007).

Differential equations

Differential equations are used to model the behaviour of complex systems. The mathematical theory of differential equations first developed with the sciences where the equations originated and where the results found application (Tonnang *et al.*, 2017).

2. For measuring and predicting area-wide impacts of natural enemies on pest population describing the spreading patterns of pests and assessing the risk of invasion to other areas.



Inductive approach

The inductive approach begins with a researcher collecting relevant data for the research study. After collecting the data, the researcher analyses it broadly, looking for patterns to develop a theory that could explain the patterns.

Deductive approach

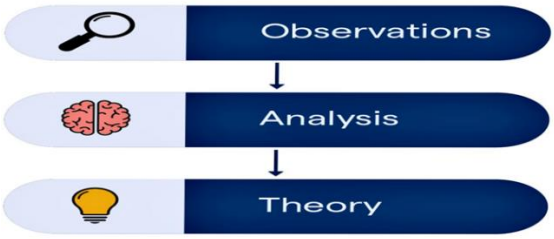
The normative or deductive approach is more concerned with what the agricultural landscape should be like, given a certain set of assumptions. This approach leads to the derivation and testing of hypotheses and, theoretically, to the development of an ideal model of agricultural location.

Predicting the efficacy of a pest management strategy

Assess Economic Impact: Calculate the cost-effectiveness of the strategy by comparing the costs of implementation against the benefits, such as increased yield or reduced crop loss. Evaluate any potential environmental effects, like effects on non-target species or the development of pest resistance (Kropff *et al.*, 1995).

Benefits of crop modelling in entomology

- Testing the scientific hypothesis
- Estimation of potential yields



- Impact assessment of climatic variability and climatic change
- Assistance in genetic improvement
- Evaluate optimum genetic traits for specific insect infestation
- Evaluate cultivar stability under various infestations

Challenges and limitations of crop modelling

❖ **Data accuracy:** Obtaining accurate data on insect populations and behaviours poses a. challenge for precise modelling.

❖ **Variable Environmental Factors:** The dynamic nature of environmental conditions influences the accuracy of predicting insect behaviour.

❖ **Complex Interactions:** The intricate interplay of different insect species and their impact on crops adds complexity to modelling.

❖ **Lack of Long-term data:** The scarcity of long-term insect population and behaviour data hinders accurate modelling for future scenarios.

❖ **Skilled Manpower:** There is a need for skilled manpower with good computer skills.

CONCLUSION

Crop modelling is a holistic and knowledgeable approach. Crop modelling in entomology offers valuable insights into pest

management strategies. By utilizing data-driven models, researchers can make decisions to safeguard crop yield and quality. This approach is crucial for sustainable agriculture and future advancements in entomology research. The crop model helps us in assimilating knowledge gained from experimentation. It offers dynamic, quantitative tools for analysing the complexity of agricultural systems. Promote interdisciplinary research.

REFERENCES

Dalal, P. K., and Singh, J. K. (2017). Role of modelling in insect pest and disease management. *Journal of Entomology and Zoology Studies*, *5*(5), 1773-1777.

Dhaliwal LK, Hundal SS, and Kular JS. Use of agrometeorological indices for forecasting of Mustard aphid (*Lipaphis erysimi*). J Agromet. 2005; 7:304-306.

Kropff, M. J., Teng, P. S., and Rabbinge, R. (1995). The challenge of linking pest and crop models. *Agricultural Systems*, *49*(4), 413-434.

Messousi HE, Hafid H, Lahrouni A, and Afif M. Simulation of temperature effect on the population dynamics of the Mediterranean fruit fly, *Ceratitis capitata* (Diptera; Tephritidae). J Agron. 2007; 6:374:377

Reynolds, M., Kropff, M., Crossa, J., Koo, J., Kruseman, G., Molero Milan, A., and Vadez, V. (2018). Role of modelling in international crop research: overview and some case studies. *Agronomy*, *8*(12), 291.

Tonnang, H. E., Hervé, B. D., Biber-Freudenberger, L., Salifu, D., Subramanian, S., Ngowi, V. B., Guimapi, R. Y.A., Anani, B., Kakmeni, F. M.M., Affognon, H., Niassy, S., Landman, T., Ndjomatchoua, F.T., Pedro, S.A., Johansson, T., Tanga, C.M., Nana, P., Fiaboe,K.M., Mohamed, S.F., Maniania, N.K., Nedorezov, L.V., Ekesi, S. & Borgemeister, C. (2017). Advances in crop insect modelling methods—Towards a whole system approach. *Ecological Modelling*, *354*, 88-103.