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Resistance of Host Plants to Pests and Role of Insect Pests in Crop Production in India

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Host pant resistance (HPR) describes a range of adaptations evolved by plants which improve their survival and reproduction by reducing the impact of herbivores. Plants use several strategies to defend against damage caused by herbivores. Plant resistance defined as the Relative amount of heritable qualities that influence the ultimate degree of damage done by the insect (R.H. Painter, 1951). The term resistance coined by Painter and study of resistance against insect pests and published his book Insect Resistance in Crop Plants. R.H. Painter is widely recognized as the "Father of Host Plant Resistance". Host plant resistance to insect is a conventional approaches and phenomenon of interrelationship between host plants and affected by environmental factors. Those heritable characters possessed by the plant which influence the ultimate degree of damage done by the insects. 1st reported of resistance wheat variety 'Underhill' of resistant to Hessian fly, *Mayetiola destructor*. One of the outstanding successes in utilizing Host Plant Resistance in pest management was the control of Grape Phylloxera. In 3rd Century BC Theophrastus recorded difference in disease susceptibility among crops. "Underhill" variety of wheat reported resistant to Hessian fly. Sorghum crop reported to be resistant to grasshoppers, *Melanoplus spp.* variety of apple "Winter Majetin" is reported resistant to woolly apple. Control of grape phylloxera in Europe by grafting of European grapevine scions to resistant North American root stocks. The first BPH – resistant variety with Bph 1gene, 1R26, was released. Resistant variety is good tool for insect pest and ecological sound and not hazardous to environment. India is an agriculturally diverse country, cultivating a wide range of crops that are vulnerable to various insect pests. The resistance of host plants to pests is a critical aspect of crop production in India, given the country's heavy reliance on agriculture for food security and economic growth.

Keyword: Resistance, Antibiosis, Heritable, Reproduction, Biochemical and Biophysical Factor.

Resistance of Host Plants to Pests

1. Types of Plant Resistance

R.H. Painter (1951) has three main grouped the mechanism of resistance which is given below:-

Antibiosis: The word Antibiosis was coined by Kogan and Orthman (1978). Adverse effect of the host plant on the biology (survival, development and reproduction) of the insects and their progeny due to the biochemical and biophysical factors present in it. Manifested by larval death, abnormal larval growth, etc.

Antibiosis may be due to:

i. Presence of toxic substances.
ii. Absence of sufficient amount of essential nutrients**.**
iii. Nutrient imbalance/improper utilization of nutrients.

Chemical factors in Antibiosis - Examples

S. No.	Chemicals present in plants	Imparts resistance against
1	DIMBOA (Dihydroxy methyl benzoxazin)	Against European corn borer, *Ostrinia nubilalis*
2	Gossypol (Polyphenol)	*Helicoverpa armigera* (American bollworm)
3	Sinigrin	Aphids, *Myzus persicae*
4	Cucurbitacin	Cucurbit fruit flies
5	Salicylic acid	Rice stem borer

Antixenosis (Non-Preference): The word Non-Preference was given by R. H. Painter. Non-preference is also called Antixenosis. Antixenosis derived from two Greek words anti and xenosis**,** anti means against and xenosis means expelling guest. It is the mechanism employed by host plant to deter or reduce colonization in insect. Host plant characters responsible for non-preference of the insects for shelter, ovipositon, feeding, etc. Plants exhibit traits that deter pests from feeding or laying eggs. It denotes presence of morphological or chemical factor which alter insect behavior resulting in poor establishment of the insect.

E.g.,

i. Trichomes in cotton - resistant to whitefly.
ii. Wax bloom on crucifers leaves - deter feeding by DBM.
iii. Plant shape and colour also play a role in non preference.
iv. Open panicle of sorghum – Supports less Helicoverpa.
v. Involves ethylene signaling factor of tomato - Potato aphid (*Macrosiphum euphorbiae*).
vi. Behavior-modifying compounds of wheat - Alarm pheromone wheat aphids.

Tolerance: The pant showing tolerance has ability to withstand heavy insect infestation Plants possess the ability to endure pest damage without significant yield loss. It is generally attributable to plant vigour, regrowth of damaged tissue, to produce additional branches, compensation by growth of neighboring plants. The mechanisms of tolerance of plants to aphids. Tolerance is often coupled with antibiosis, and the latter may explain the increased yield sufficiently for tolerance not to be identified. The examples of tolerance reported in the literature therefore tend to be dramatic, with crop growth and yield little affected despite high aphid infestation. For example found that three triticale (x *Triticosecale* spp.) accessions showed difference in shoot length whether infested or uninfected with *R. padi*.

2. Mechanisms of Plant Resistance

- **Chemical Defenses:** Plants produce compounds like alkaloids, phenolics, and terpenoids that repel or harm pests.
- **Physical Barriers:** Some plants have structures like thorns, hairs, or tough leaves that make them less accessible or palatable to pests.
- **Genetic Resistance:** Breeding programs focus on developing cultivars with inherent resistance to specific pests.

3. Benefits of Host Plant Resistance

- Reduces dependence on chemical pesticides, promoting environmentally friendly agriculture.
- Mitigates crop losses caused by pests, ensuring higher yields and food security.
- Facilitates sustainable pest management, particularly when integrated with other strategies like IPM.

Role of Insect Pests in Crop Production in India

1. Pest Diversity and Impact

- India's diverse agro-climatic conditions harbor a wide array of insect pests that affect various crops, leading to substantial yield losses if not managed effectively.
- Pests such as the bollworm in cotton, stem borers in rice and maize, fruit flies in fruits, and several others pose significant threats to crop productivity.

2. Economic Impact

- Insect pests can cause severe economic losses by reducing crop yields, quality, and market value. This impacts the livelihoods of millions of farmers across India.

3. Challenges Faced

- Rapid population growth, climate change, and globalization contribute to evolving pest dynamics, leading to the emergence of new pests and altered behavior of existing ones.
- Pesticide resistance in pests is a growing concern, necessitating sustainable pest management practices.

4. Importance of Pest Management

- Effective pest management practices, including host plant resistance, integrated pest management (IPM), and biocontrol, are crucial for minimizing pest damage and ensuring adequate crop yields.

Conclusion

The resistance of host plants to pests is indispensable for sustainable crop production by leveraging plant resistance mechanisms and implementing comprehensive pest management strategies, including research into resistant cultivars and integrated pest management practices, India can mitigate the detrimental effects of insect pests on crop yields, ensuring food security and economic stability in agriculture.

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