TYPES AND MECHANISMS

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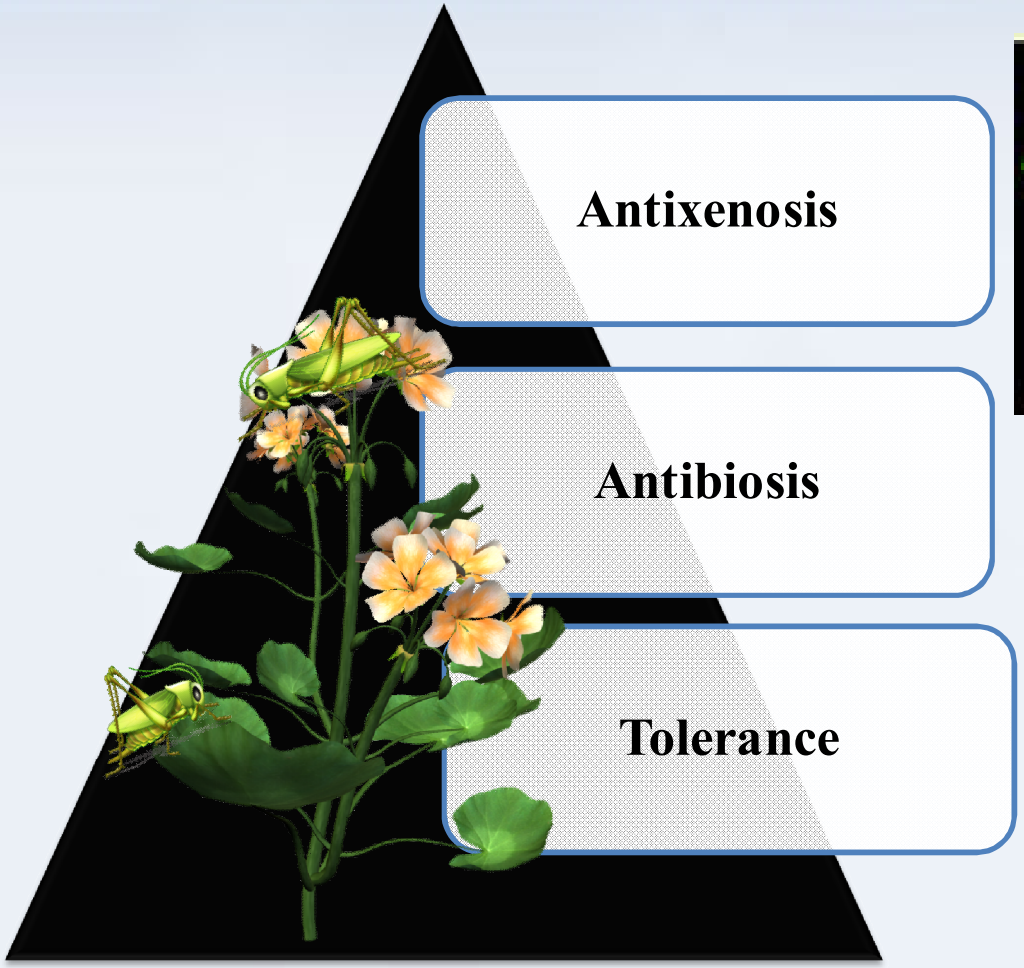
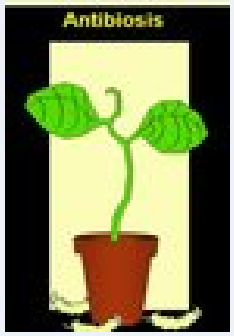
MECHANISM OF RESISTANCE



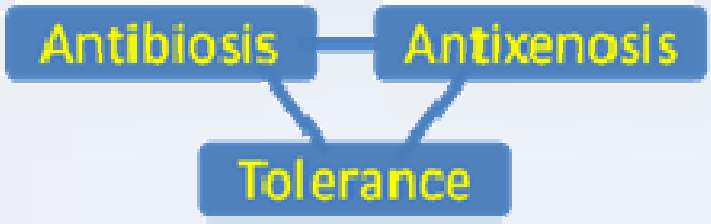
Antixenosis

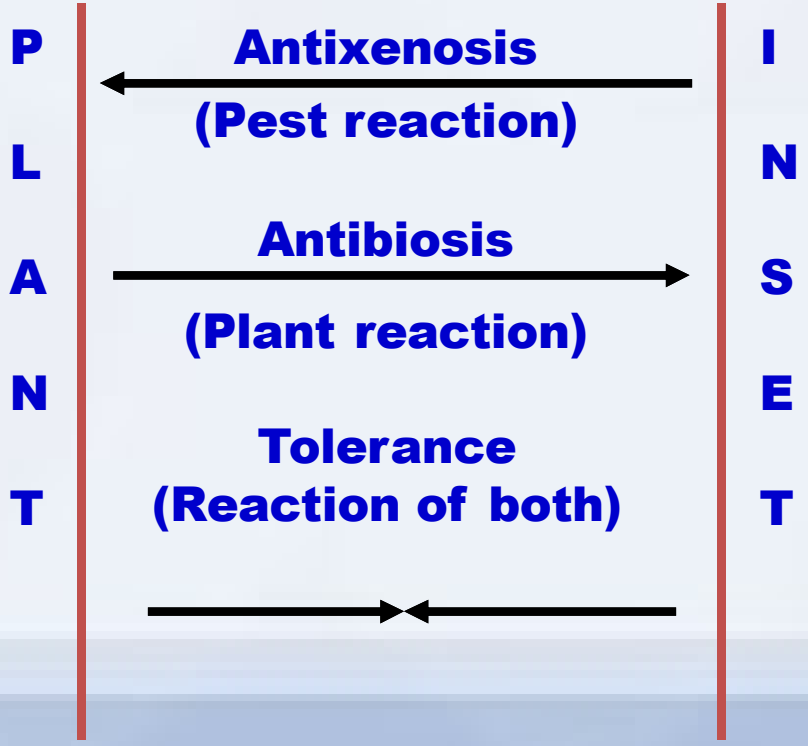
Antibiosis

Tolerance



Three fold basis Resistance based insect plant interaction according to Painter (1951) is





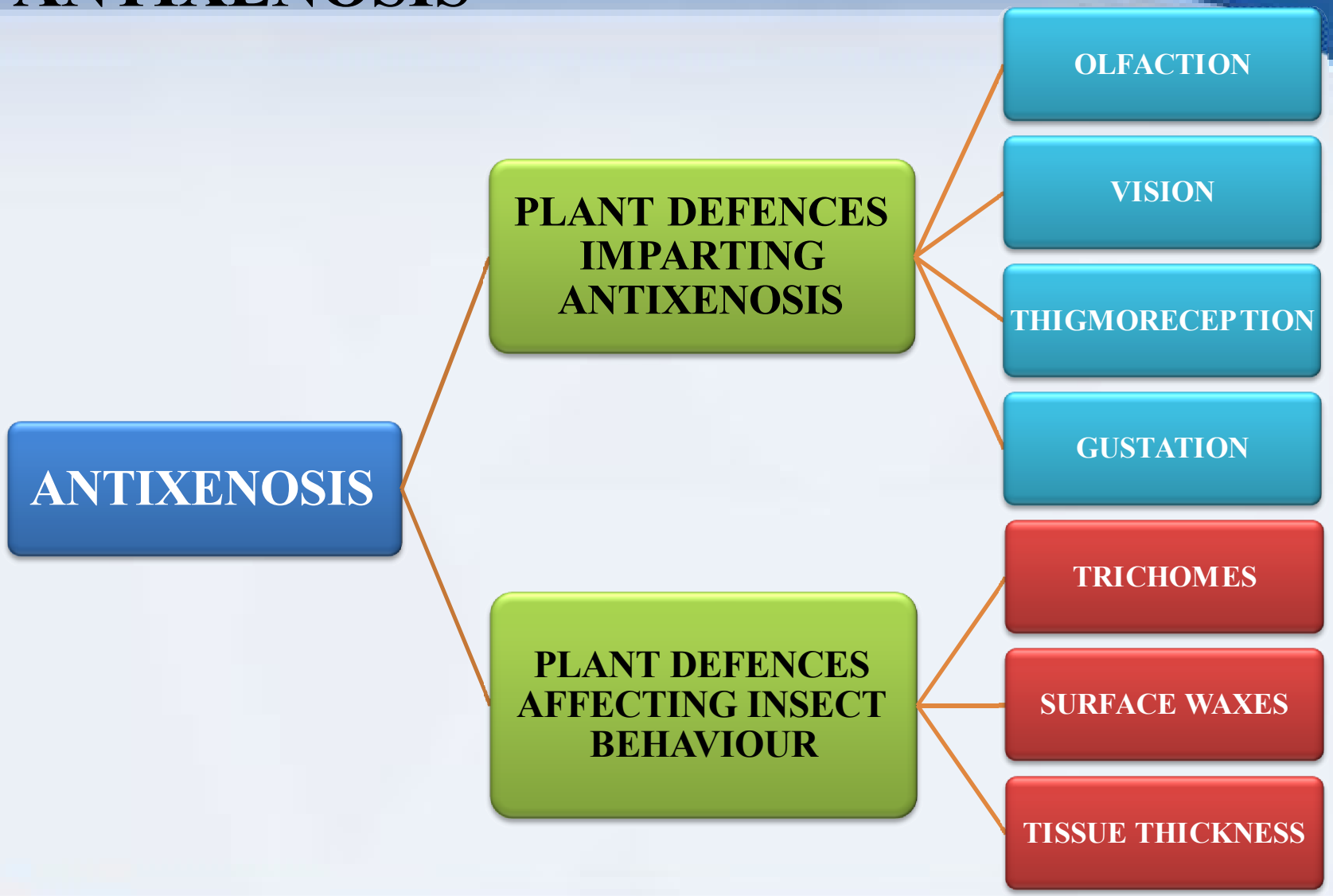
Antixenosis (Non acceptance)

Xeno- meaning guest

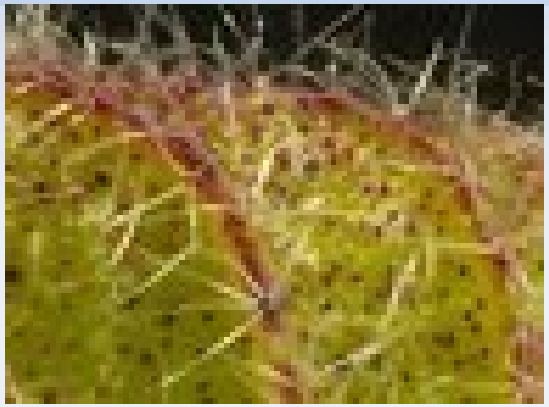
Type of resistance where insect will not accept for feeding & breeding even if there is no alternative source.

- Host plant characters responsible for non-preference of the insects for shelter, oviposition, feeding, etc.
- It denotes presence of morphological or chemcial factor which alter insect behaviour resulting in poor establishment of the insect

ANTIXENOSIS



Examples for antixenosis



Trichomes in cotton - resistant to whitefly

Wax bloom on crucifer leaves - deter feeding by DBM

Plant shape and colour also play a role in non preference

Open panicle of sorghum - Supports less Helicoverpa

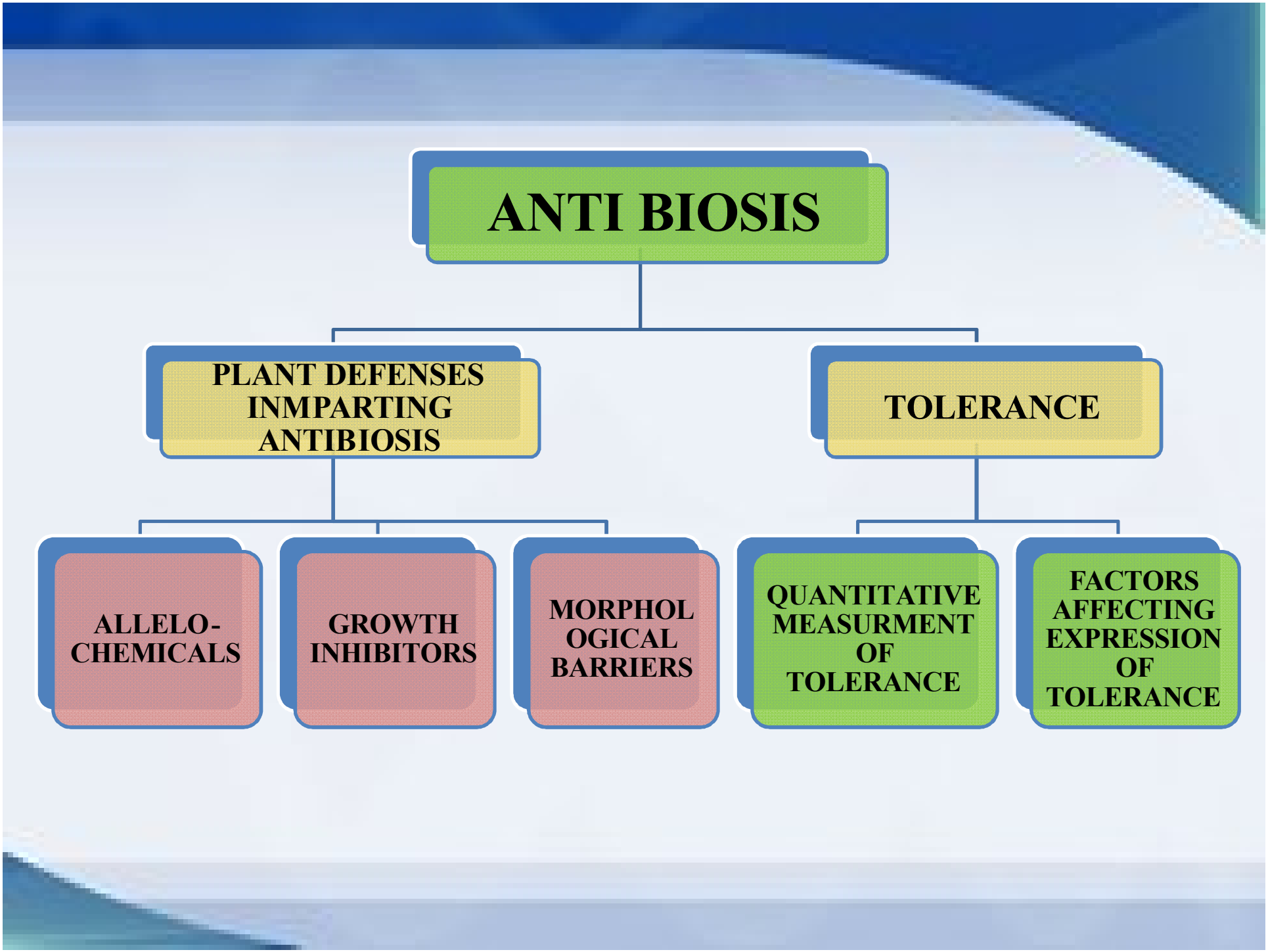
Table 1. Important non preference characters

Insect pests	Host plant characters	
	Non-preference	Preference
Bollworms	Smooth leaves	Hairy leaves
	Nectarileness	Nectarine
	Long pedicel	Short pedicel
	Thick boll rind	Thin boll rind
	Okra leaf	Soft boll rind
Boll weevil	Frego bract	Normal bract
	Red plant body	Green plant body
	Hairy leaves	Smooth leaves
	Leathery leaves	Succulent leaves
Whitefly	Smooth leaves	Hairy leaves
	Thin leaves	Normal leaves

ANTIBIOSIS

- 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
- It may be due to :
  a. Presence of toxic substances-
  b. Absence of sufficient amount of essential nutrients
  c. Nutrient imbalance/improper utilization of nutrients

Chemical means	Physical means
DIMBOA (Dihydroxy methyl benzoxazin) against **European corn borer**	**Thick cuticle**
Gossypol against **American boll worm**	**Glandular hairs**
Sinigrin against **Aphids**	**Silica deposits**
Cucurbitacin against ***Myzus persicae***	**Tight leaf sheath**


ANTI BIOSIS
PLANT DEFENSES INMPARTING ANTIBIOSIS
TOLERANCE
ALLELO-CHEMICALS
GROWTH INHIBITORS
MORPHOLOGICAL BARRIERS
QUANTITATIVE MEASURMENT OF TOLERANCE
FACTORS AFFECTING EXPRESSION OF TOLERANCE

- The effects may be

Direct

1) Growth
2) Development
3) Reproduction
4) Survival
5) General vigour

Indirect

1) Vulnerability to biocontrol agents
2) Vulnerability to environmental aberration
    - Overal all effect is reduction in rate of population increase
    - Often mechanisms of antixenosis and antibiosis overlap

Toxins of Plant origin

- Lectin
- Lectin phytoheamaglutinin
- Wheat germ agglutinin

- Snowdrop lectin, *Galanthus nivalis* Sucking pests, Pulse beetle and storage pests

Enzymes & Enzyme inhibitors

- Protease inhibitors
- Trypsin inhibitors
- Alpha amylase inhibitors

- Leguminacea
- Solanaceae
- Poaceae

Table 2. Biochemical components

Components	Confer resistance
High gossypol	Bollworms, tobacco budworm and red spider mite
High phenol	Bollworms
High condensed tannin	Bollworms, aphids, lygus bugs, red spider mites and leaf miners
High tannin	
In leaves	Jassids
In buds	Bollworm tolerance
Low sugar	
In anther	Boll weevil and bollworms

Jenkins, 1994 (USA)

Tolerance

- Ability of the plant to grow and reproduce and even repair injury to a marked degree inspite of supporting a population approximately equal to that damaging a susceptible host
- Plant is damaged but there is no economic yield loss or lowering of quality
- Often tolerance is confused with low level of resistance or moderate resistance
- It totally different from other two causes by not coming in/on to the way of insect activity

- Therefore, it may be regarded as susceptible based on insect number or damage
- It is an adaptive mechanism for the survival of plant and is more or less independent of the effect upon the insect
- This type of resistance refers strictly to resultant effects and not to mechanisms.

Insect-resistant cultivar developed for different crops in India

Common name	Scientific name	Cultivar
Cotton		
American bollworm	*Helicoverpa armigera*	Sujata, Abadhita, Sujay
Pink bollworm	*Pectinophora gossypiella*	LD135, Sujata, Abadhita
Spotted bollworm	*Earias vittella*	LD1245, Sanguineum
Cotton jassid	*Amarsca bigutulla*	Mahalaxmi, Sujay
Sugarcane		
Internode borer	*Chilo sacchariphagus indicus*	Co6806, Co975
Top borer	*Scirpophaga exercerptalis*	Co7224, Co1158
White grubs	*Holotrichia spp.*	Co6304, Co5510
Maize		
Maize shoot fly	*Atherigona sp.*	DMR5, VC80
Pink stem borer	*Sesamia innferens*	Deccan 101 and 103
Rice		
Brown plant hopper	*Nilaparvata lugens*	IET7575, Jyoti
Gall midge	*Oaseolia virens*	Phalguna, IR36
Yellow stem borer	*Scirpophaga incertulas*	Ratna, MTU5849

Groundnut		
Leaf miner	*Aproaerema modicella*	ICGV86031, ICG57
Tobacco leaf caterpillar	*Spodoptera litura*	ICGV86031, FDRS 10
Soyabean		
Leaf miner	*Aproaerema modicella*	Nimsoy, PL507
Chick pea		
Pod borer	*Helicoverpa armigera*	Anupani, ICCV10, Dulia
Pigeon pea		
Pod borer	*Helicoverpa armigera*	Bori, ICPL332, BSMR 1
Brinjal		
Shoot and fruit borer	*Leucinodes orbonalis*	Pusa purple long, SM68
Jassid	*Empoasca kerri*	Krishna, UPB 1
Potato		
Potato tuber moth	*Phthorimaea operculella*	QB 1A 21-29
Tomato		
Fruit borer	*Helicoverpa armigera*	Pant bahar, BT 1, T 32

A. Advantages of host plant resistance

- Cumulative and persistent
- No additional cost to grower (other than purchasing seed resistant to pests.
- No harmful residues
- No damage to beneficial fauna
- Integrates effectively with other control methods
- Conserves bio-control agents
- Most useful in low economic crops.

B. Primary disadvantages of host plant resistance

- Several years to develop for one pest, longer for multiple resistance
- Different varieties needed for different geographical areas
- Need for good agronomic quality along with resistance
- Resistance most offen found in species of off types of poor agronomic quality require much time to develop to an acceptant variety
- Biotypes. Insects adapt or change so as to feed on formerly resistant plants
- Incompatibility of resistance character with other characters
- Replacement of varieties by better yielders

Compatibility of HPR in IPM

a. Compatibility with chemical control

- HPR enhances efficacy of insecticides
- Higher mortality of leaf hoppers and plant hoppers in resistant variety compared to susceptible variety
- Lower concentration of insecticide is sufficient to control insects on resistant variety

b. Compatibility with biological control

- Resistant varieties reduce pest numbers - thus shifting pest: Predatory (or parasitoid) ratio favourable for biological control. e.g. Predatory activity of mirid bug *Cyrtorhinus lividipennis on BPH was more on a resistant rice variety IR 36* than susceptible variety IR 8
- Insects feeding on resistant varieties are more susceptible to virus disease (NPV)

c. Compatibility with cultural method

- Cultural practices can help in better utilization of resistant varieties. e.g. Use of short duration, pest resistant plants effective against cotton boll weevil in USA.

Advantages of HPR as a component in IPM

- Specificity: Specific to the target pest. Natural enemies unaffected
- Cumulative effect: Lasts for many successive generations
- Eco-friendly: No pollution. No effect on man and animals
- Easily adoptable: High yielding insect resistant variety easily accepted and adopted by farmers. Less cost.
- Effectiveness: Res. variety increases efficacy of insecticides and natural enemies
- Compatability: HPR can be combined with all other components of IPM
- Decreased pesticide application: Resistant varieties requires less frequent and low doses of insecticides
- Persistence: Some varieties have durable resistance for long periods
- Unique situations: HPR effective where other control measures are less effective

  e.g. a. When timing of application is critical

  b. Crop of low economic value

  c. Pest is continuously present and is a single limiting factor

THANK YOU