MECHANISMS OF PLANT RESISTANCE TO INSECTS

Painter (1951) grouped mechanisms of resistance into three main categories, viz. **Non-preference, antibiosis and tolerance**. As the term non-preference pertains to the insect reaction and not to the host plant characteristics, **Kogan and Ortman** (1978) proposed the terms **antixenosis** to describe the host plant properties responsible for non-preference.

1. Antixenosis

Antixenosis refers to the resistance mechanism employed by host plant to deter or reduce colonization by insects. The plants may deter the insects from feeding, oviposition and/or seeking shelter, and the insects are unable to colonize. Antixenosis signifies that the plant is considered an undesirable or a bad host. Antixenosis may result from certain morphological characteristics or the presence of allelochemicals in the host plant (Kogan, 1994). Antixenosis may represent one or more breaks in the chain of responses leading to oviposition or feeding. These breaks may be due to (1) the absence of an arrestant or attractant, (2) the presence of a repellent, or (Hi) an unfavourable balance between an attractant and a repellent (Panda and Khush, 1995).

Under certain circumstances, antixenosis can be quite important, especially when light infestations cause severe damage, e.g. infestation by insect vectors of plant diseases or insects, which sever growing parts or peduncles of the plants such as stem borer infestation resulting in white heads. In field plantings, antixenotic varieties frequently escape infestation and even when insects are caged on nonpreferred hosts, they lay fewer eggs and thereby develop smaller populations than those caged on susceptible varieties (Pathak, 1970).

2. Antibiosis

Antibiosis refers to the adverse effect of the host plant on the biology (survival, development or reproduction) of the insects and their progeny infesting it. All these adverse physiological effects of permanent or temporary nature following ingestion of a plant by an insect are attributed to antibiosis. The insects feeding on resistant plants may manifest antibiotic symptoms varying from acute or lethal to sub-chronic or very mild.

The most commonly observed symptoms in insects include adverse effect on the nutritional physiology of the insect including consumption, assimilation, utilization and subsequent allocation for reproduction (Ananthakrishnan, 1994). This is manifested by **larval death in first instars**, **abnormal growth rates**, **disruption in conversion of ingested food**, **decline in size and weight of larvae or nymphs**, **prolongation of larval period, failure to pupate, failure to of adult to emerge from pupae, abnormal adults, inability to concentrate food**

reserves followed by failure to hibernate, decreased fecundity, reduction in fertility, restlessness and abnormal behaviour (Panda and Khush, 1995).

These symptoms may appear due to various physiological processes, viz **presence of toxic substances, absence or insufficient amount of nutrient, nutrient imbalance, presence of anti-metabolites and enzymes adversely affecting food digestion and utilization of nutrients** (Kogan, 1994).

3. Tolerance

Tolerance refers to the ability of the host plant to withstand an insect population sufficient to damage severely the susceptible plants. It is generally attributable to plant vigour, regrowth o damaged tissues, resistance to lodging, ability to produce additional branches, utilization of non-vital parts by insects and compensation by growth of neighbouring plants. However, tolerance has no adverse effect on the insect infestation for longer periods without loss in yield or quality than the susceptible varieties and enables them to frequently escape insect damage through compensation by the plants. As tolerance is not likely to provide a high level of resistance, it could be useful in „ combination with other mechanisms of resistance.

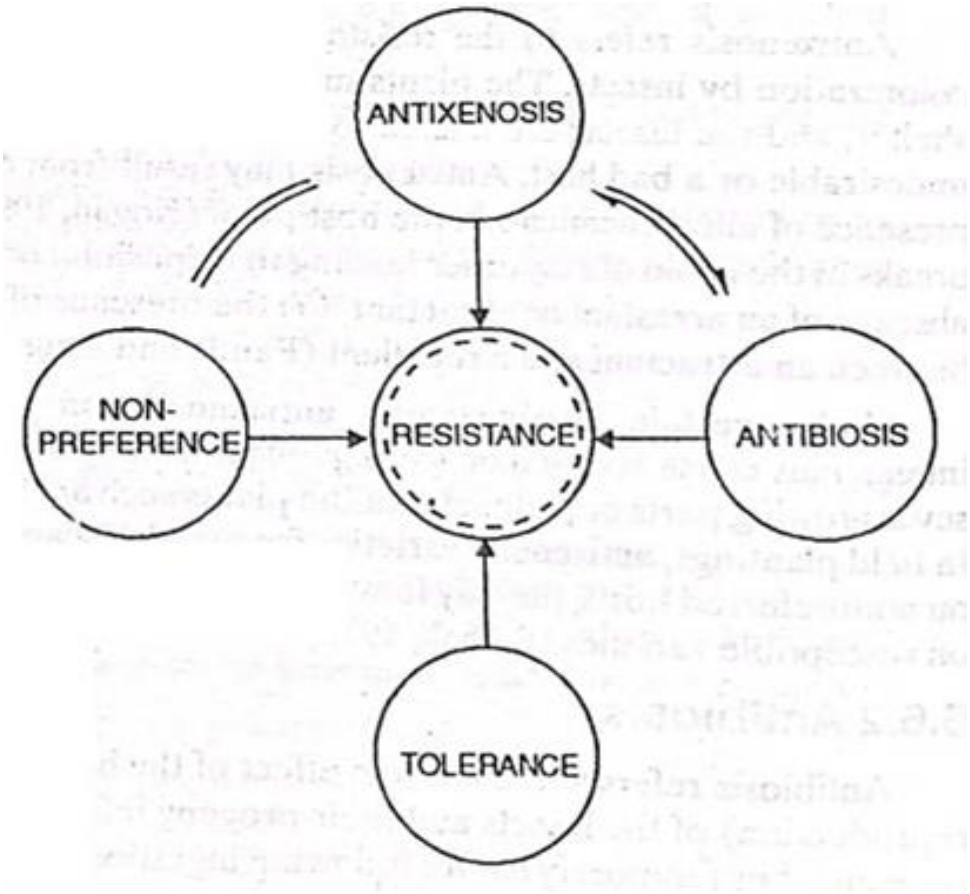
Tolerance is useful in pest management programmes due to certain distinct advantages (Panda and Khush, 1995):

- Tolerant varieties have a higher economic threshold level than the susceptible varieties and hence require less insecticide application and promote biocontrol.
- Tolerant varieties do not depress insect populations nor do they provide any selection pressure on the insect and thus are useful in preventing the development of insect biotypes.
- In varieties with a combination of three mechanisms of resistance, tolerance increases yield stability by providing at least a moderate level of resistance, when vertical genes providing a high level of resistance through antixenosis and antibiosis succumb to the new biotypes.

Although the above widely recognised classification of mechanisms appears to provide a generally acceptable breakdown of the phenomenon of host plant resistance, however, under certain circumstances, some overlap may occur between antixenosis and antibiosis and these may not be clearly separated from each other due to the presence of extreme deterrent chemicals and/or physical factor(s) in the plant cultivar. In other words, the toxins and deterrent chemicals in the plant are sometimes difficult to distinguish. The same maybe the case of certain morphological characteristics of the plant such as leaf trichomes or tissue toughness. Moreover, there are often overlaps between, the morphological and biochemical bases of resistance (Panda and Khush, 1995).

Antixenosis refers to undesirability, i.e. avoidance by insect whereas antibiosis refers to unsuitability, i.e. adverse effects on the insect after feeding on the host plant. However, sometimes it becomes difficult to separate the two mechanisms unless the insect plant relationship is fully examined. For example, *Eruca sativa* (taramira) is not a preferred host of mustard aphid, *Lipaphis erysimi* (Kaltenbach). The growth and

development of this insect was observed to be slower on *E. sativa* as compared to that on Brassica species in confinement. The mechanism appeared to be antibiosis, but it has been found that the poor development was due to reduced feed uptake because of the presence of certain allelochemicals in *E. sativa*, indicating antixenosis (Dhaliwal et al., 1993).



Mechanism involve in plant resistance to insects