UNIVERSITY OF SARGODHA

Plant resistance to insect pests

Dr. M. Asam Riaz

Assistant Professor

Entomology, College of Agriculture, University of Sargodha, Sargodha, Pakistan

Factors mediating the expression of resistance

1. Physical factors
    - A. Temperature
    - B. Light intensity
    - C. Soil fertility
2. Biological factors
    - A. Biotype
    - B. Plant age
    - C. Pathogen

Physical factors

I. Weather, soil, plant architecture, and cultural practices etc

II. These factors can affect plant resistance by influencing such elements as

A. Temperature

- –**High or low temperature** for a period of time may cause loss of resistance
- –E.g., low temperature caused lost of resistance in
  - **» alfalfa genotypes** to spotted alfalfa aphid and pea aphid
  - »**Sorghum genotype** to greenbug

B. Light intensity

- –Shade induced loss of resistance
  - »E.g., **Sugar beets** loss resistance to aphid
  - »**Potato loss resistance** to colorado potato beetle (shading reduced the levels of steroidal glycosides in leaves)

C.Soil fertility

–Changes in **soil-nutrient levels** may also mediate resistance

» e.g., **resistance of alfalafa** to aphid reduce due to deficiency of Ca or K or excess of Mg and N.

» Resistance increased by **deficiency of P.**

» **Resistance to Bt against Heliothis reduced by Mg (Riaz et al., 2016)**

III.Changes in these elements cause changes in **plant physiological processes** and can alter levels of allelochemics or cause imbalances in basic nutrients

2.Biological factors

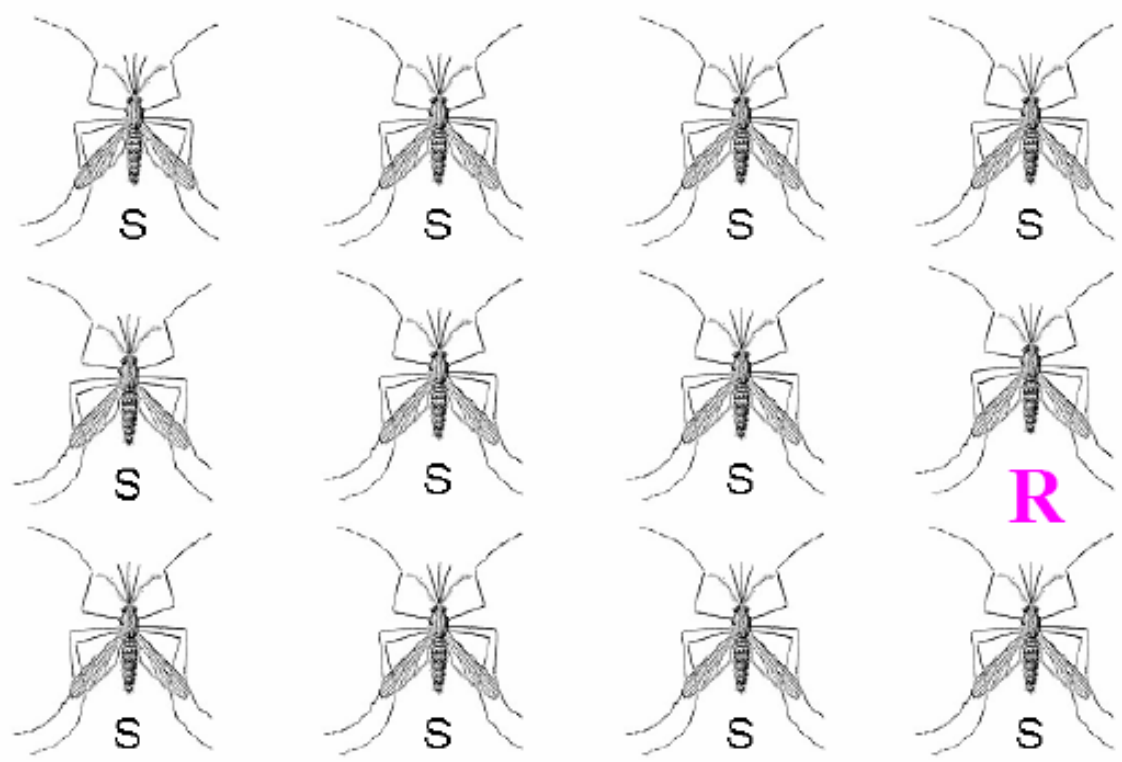
A. Biotype

1.When resistant cultivars are grown widely, **selection pressure** is imposed by these hosts on insect population

2.Insect population responds with virulent genotypes of insects

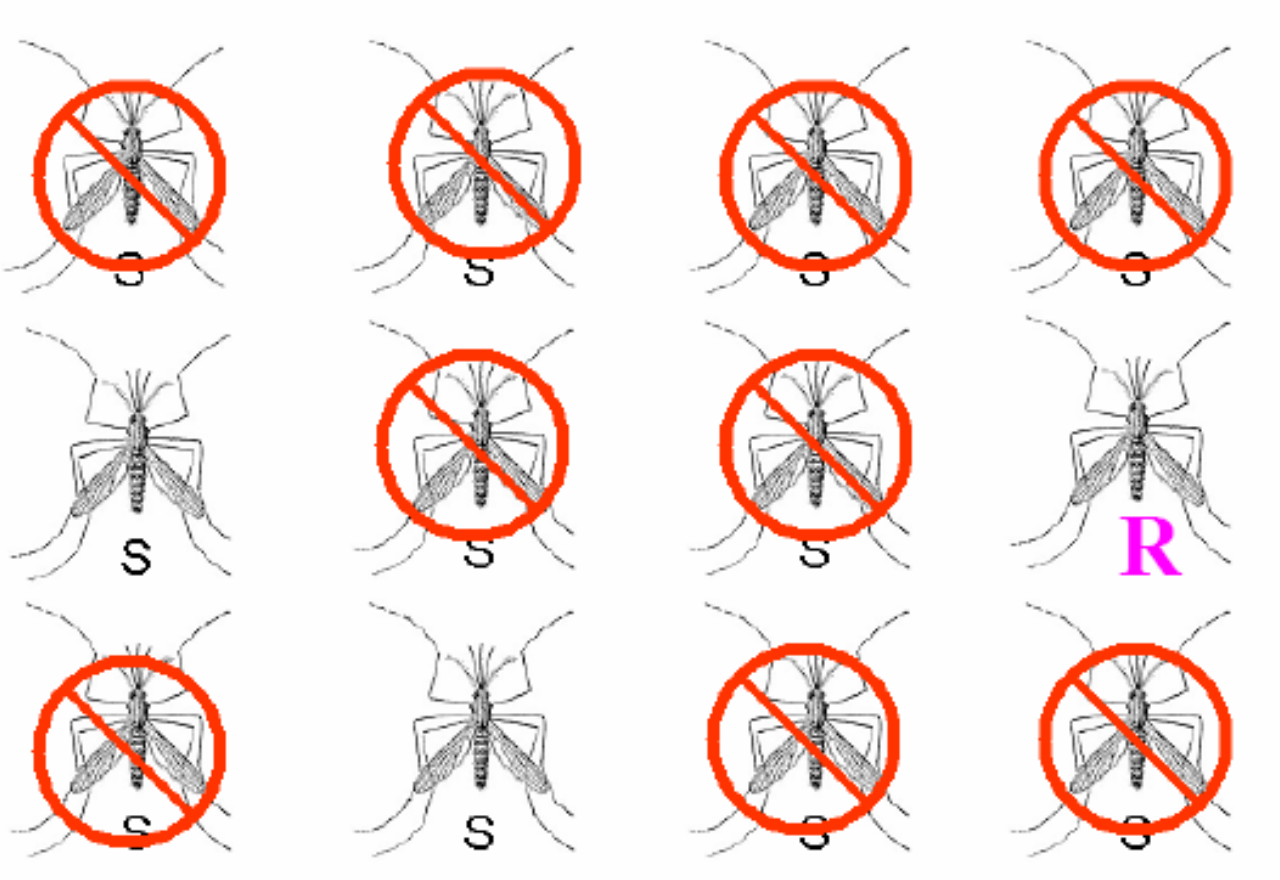
3.With the passage of time, virulent genotype (of insect) increase in number, displacing avirulent type

Evolution of insect resistance. How does it occur?



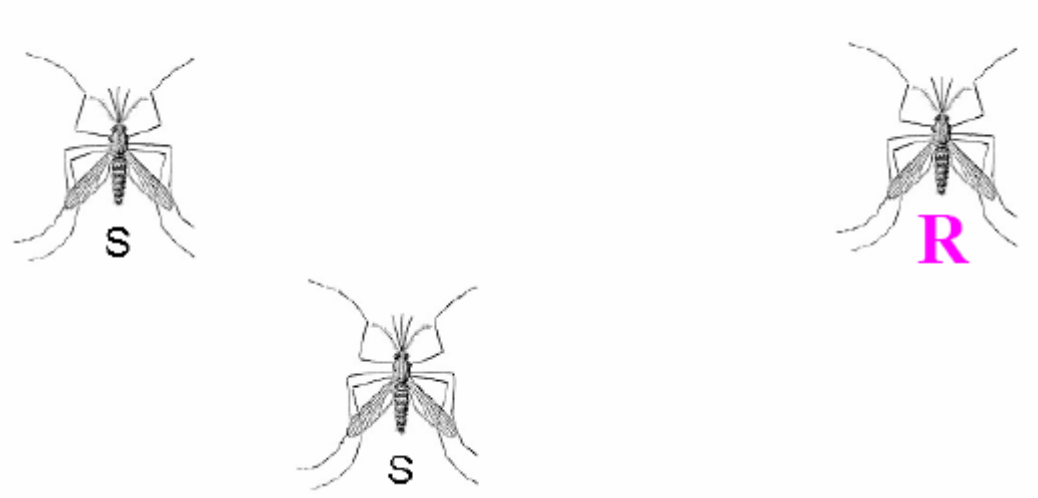
- Individuals in a population are never equally susceptible to a plant. Plant-resistant **R genotype** is present.
- E.g., in this case, frequency of R genotype in the above figure is 1/12 = **0.083**

Evolution of resistance



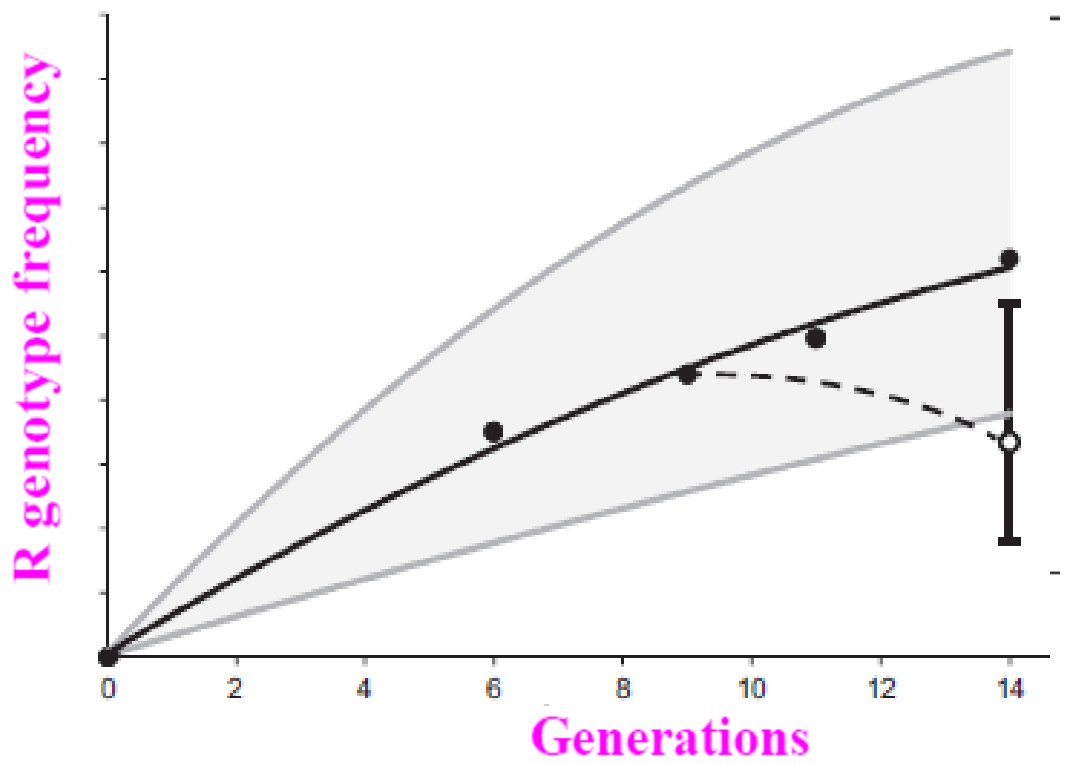
The use of resistant plants is leaving plant-resistant individuals (their R genotype) and some susceptible individuals (S genotype)

Evolution of resistance



Now, the frequency of resistant R genotype is 1/3 = 0.333

Evolution of resistance



Under the selection pressure, R genotype frequency keep on increasing generation after generation.

Riaz et al., 2013-Aquatic Toxicology

Evolution of resistance

- **Resistance:** occur through selection pressure
- **Selection acts on** genetically. Variation in susceptibility arise from:
  - Mutation, the source of all new genetic variation
  - Genetic recombination that rearranges genetic variation
  - Gene flow from populations having different allelic frequencies

4.Result: ineffectiveness of the resistant cultivars

5.Time for biotype development varies

e.g.,

few years for Brown planthopper resistance in rice

50 years for leafhopper resistance in cotton cultivars

B. Plant age :

- Corn resistance to corn borer at early stage because of **DIMBOA (2,4-dihydroxy-7-methoxy-1,4-benzoxazine-3-one).**
- Level of DIMBOA declines as the season progress.
- **Corn cultivars** have **maximum resistance** to first generation corn borer

C. Plant pathogens (induced resistance in plants has already been discussed)

(Simeon O Kotchoni and Emma W Gachomo 2006. J. Biosci. 31(3), September 2006, 389–404)

(Karban 1989. Annual Review of Entomology)