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*General Entomology (3) 240E; for 2<sup>nd</sup> year students*

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**Answers questions**

**AQ1- Write briefly on the following (select two only):**

**(12 marks)**

- **Bioactive Specialized Compounds with one example (compound).**

Chemical compounds produced by plants have traditionally been divided into primary and secondary metabolites. The primary metabolites are used for growth, development and reproduction. The secondary metabolites, nowadays known as bioactive specialized compounds, are on the other hand used to protect the plant against herbivory and microbial pathogen infection, to attract pollinators and seed-dispersing animals, and as agents in plant-plant competition and plant-microbe symbiosis. Bioactive specialized compounds are targeted especially against biological systems unique to herbivores, such as the nervous, digestive and endocrine organs], and are produced both constitutively and upon induction. Bioactive specialized compounds also make a major contribution to the specific odors, tastes and colors of plants. In general, bioactive specialized compounds may act as repellents for generalist insects, and as attractants for specialist insects. Toxic compounds will intoxicate generalist herbivores, while specialists are forced to invest resources in detoxification mechanisms, and their growth and development will therefore slow down. Bioactive specialized compounds are Alkaloids, Cyanogenic Glucosides, Glucosinolates Phenolics and Terpenoids.

- **Volatiles considered an Indirect Defense Response.**

More than 1000 volatile organic compounds (VOCs), primarily consisting of 6-carbon aldehydes, alcohols, esters and various terpenoids are released from plant flowers, vegetative parts or roots. VOCs are used to attract pollinators and predators or repel herbivores as well as in communication between or within plants. Furthermore, VOCs have been shown to be released from the plant in huge amounts when it is attacked by herbivores. Other VOCs like methyl salicylate and methyl jasmonates, monoterpenes such as limonene, linalool are usually released within 24 h after attack. Studies have shown that predators associate VOCs, especially terpenoids, with the presence of prey.

- **Characterization of antibiosis.**

Antibiosis is an adverse effect that a plant may have on the pest because of chemicals or structures the plant possesses. Plants contain a wealth of chemicals some of which may be toxic to a pest or cause it to grow more slowly. Antibiosis are toxic substances that injury insect physiology. Plants produce a wide variety of defensive compounds (allelochemicals) that protect them from herbivores. These compounds may react as.

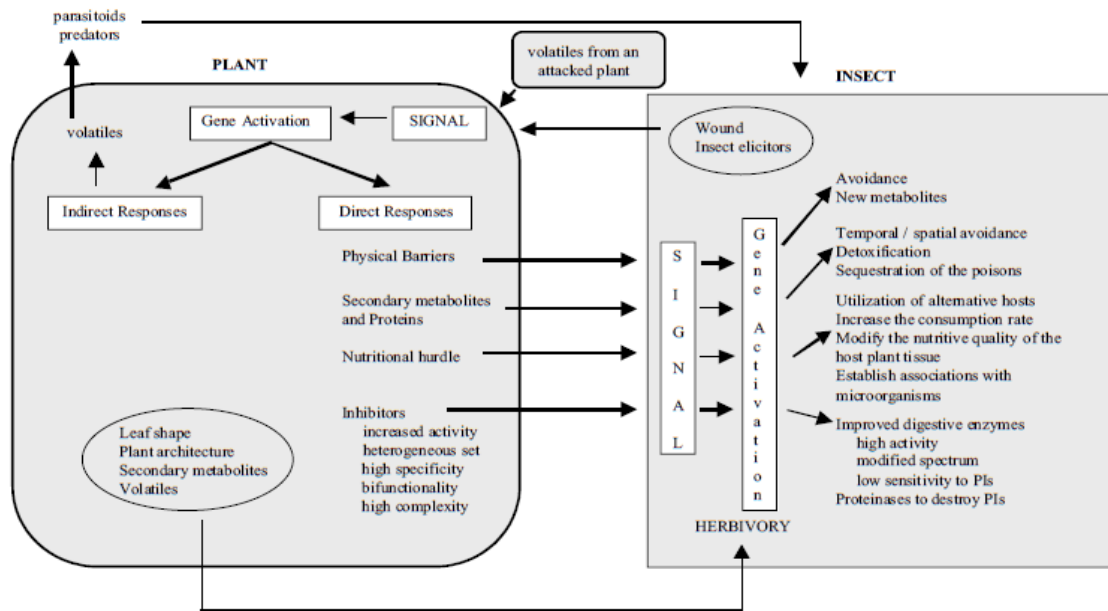
- Reduce growth
- Alter physiology
- Results in increased mortality
- Induce various physical or behavioral abnormalities.
- inhibit reproduction,
- delay maturation,
- reduced longevity

**AQ2- Mention the relation between the plants and insects**

**(8 marks)**

(From Schematic table give four interaction elements between plants and insects)

| Plant                              | insect  |
|------------------------------------|---|
| Physical Barriers                  | Avoidance New metabolites                         |
| Secondary metabolites and Proteins | Detoxification                                    |
| volatiles                          | Increase the consumption rate                     |
| Nutritional hurdle                 | Modify the nutritive quality of host plant tissue |
| increased activity                 | Improved digestive enzymes                        |



**AQ3- Give the reasons (select two only):**

**(10 marks)**

- **Generalists herbivorous insect are poorly succeeded on plants unlike Specialist Insects.**

Herbivorous insects can be divided into generalists and specialists according to their lifestyles. Specialization is defined by the number of host species; the more plant species an insect eats on. Specialists' survival is constrained by the presence of their specific host plant. Specialists can evolve adaptations such as the detoxification or the sequestration of poisons. Coevolution with specialists can create counter-adaptations in the form of insect-specific defense responses.

- **Nesting and Refuge Sites considered a once of tolerance elements.**

Some plants characterized by enable them to withstand or recover from insect or disease damage. An example of breeding for tolerance is the development of corn plants with vigorous root systems that can compensate when they are attacked by corn rootworms. Plants can offer predators like ants, mites and bugs small chambers in the juncture of the midrib and the vein used as nesting or refuge sites (domatia). Ant domatia are restricted to the tropics plant areas, while mite and bug leaf domatia can also be found in temperate regions. Removal of leaf domatia will reduce the amount of mites on the flower *Viburnum tinus* [380], while adding domatia to cotton plants will increase the numbers of trips and bugs, leading to improved plant performance.

- **Terpenoids are known as repellent and toxic effects on insects.**

Terpenoids are biosynthesized from acetyl-CoA or glycolytic intermediates. They are classified by the number of isoprene units or five-carbon elements (CH<sub>3</sub>-CH<sub>2</sub>-CH-(H<sub>3</sub>C)<sub>2</sub>); ten-carbon terpenes are called monoterpenes, 15-carbon terpenes are

sesquiterpenes, 20-carbon terpenes are diterpenes, 25-carbon terpenes are sesterterpenes, and terpenes with even more isoprene units are classified as polyterpenes. Terpenoids are the most metabolically diverse class of plant bioactive natural products. Many of them play a role in plant defense, both as components in resin or as volatiles, acting as antifeedants, repellents, and toxins or as modifiers of insect development. Many plants contain mixtures of volatile monoterpenes and sesquiterpenes called essential oils, with well-known repellent and toxic effects on insects.

- **Trichomes can be repel, deter or poison insects.**

Plant surfaces may further be covered by thorns and spines, for protection mainly against mammals, and trichomes (hairs) against insects. Removal of trichomes results in increased feeding and growth of herbivorous insects. Trichomes have moreover been shown to increase in number in response to insect feeding. Glandular trichomes contain glands that produce volatile or non-volatile bioactive natural products or proteins that repel, deter or poison insects. Non-glandular trichomes, on the other hand, prevent small insects from making contact with the surface, limit their movement or function as entrapment devices.

In addition to feeding and movement impedence, trichomes can influence the attachment of insects to the leaf surface. An enhanced level of defense is achieved by those plant species or biotypes that present glandular trichomes. Broad spectrums of chemical substances have been described from glandular trichomes such as alkaloids flavonoides, triterpenes.

**AQ4- Put the sign ✓ or X in front of each of the following statements**

**(18 Marks)**

| No. | The Statements  |   |
|-----|---|---|
| 1   | <b>Volatile</b> organic compounds are released from plant flowers, vegetative parts and roots   | ✓ |
| 2   | Some <b>Phenolics</b> amide derivatives can act as insect juvenile hormone analogs  | ✓ |
| 3   | The release of hydrogen cyanide (HCN) in plants may also damage the plant itself  | ✓ |
| 4   | Deterrents are unpalatable food like alkaloids, flavonoids, terpenes, lactones and phenols  | ✓ |
| 5   | Surface waxes are plant leaves that protected against desiccation, insect predation   | ✓ |
| 6   | Wax surface may physically prevent the movement of an insect across a leaf surface  | ✓ |
| 7   | Tolerance is resistance in which a plant is able to withstand or recover from damage caused by insect pest abundance                              | ✓ |
| 8   | Botanical insecticides considered an <b>Antibiosis</b>  | ✓ |
| 9   | Caffeic and ferulic acids are a simple phenylpropanoids ( <b>Phenolics</b> )  | ✓ |
| 10  | Latex and resins are plant products that stored under internal pressure   | ✓ |
| 11  | Trichomes can be considered as antixenosis and antibiosis   | ✓ |
| 12  | Repellents are plant defense compounds (Biochemical Factors) that prevent or reduce contact between the insect and the substrate.                 | ✓ |
| 13  | Phenolics serve as defense compounds by repelling feeding herbivores and inhibiting enzymes   | ✓ |
| 14  | Cyanogenic Glucosides after breakdown hydrolysis decomposes into toxic hydrogen cyanide (HCN) and a ketone or aldehyde                            | ✓ |
| 15  | Bioactive specialized compounds referred to plant <b>secondary</b> metabolites  | ✓ |
| 16  | <b>Lectins</b> inhibit the absorption of nutrients when contact with the glycoproteins lining the intestinal area of insect herbivores            | ✓ |
| 17  | <b>Volatile</b> organic compounds attracts pollinators and predators or repels herbivores as well as in communication between or within plants    | ✓ |
| 18  | <b>Antixenosis</b> is a host plant mechanism which includes morphological, physical or structural qualities that interfere with insect behavioral | ✓ |

*With best wishes*  
*Dr/ Mohamed M. Baz*