COURSE CODE:	CPT 502
COURSE TITLE:	Economic Entomology
NUMBER OF UNITS:	3 Units
COURSE DURATION:	2 hours for lectures, 1 hour for lab

COURSE DETAILS:

Course Coordinator: Dr O.R. Pitan
Email: femipitan@yahoo.com
Office Location: Room 242, COLPLANT Building
Other Lecturers:

COURSE CONTENT:

An introduction to Integrated Pest Management (IPM): IPM history, conceptual foundations and basic principles. Basic tenets of integrated pest management emphasizing ecological principles; integration of chemical, biological, cultural and physical tactics into an overall strategy for the agroecosystem; chemical pesticides, cultural practices, host resistance, biological control, sterility principle, economics of pest control and pest/host relationships.

COURSE REQUIREMENTS:

The course is compulsory for all final-year students of Crop Protection. Students are expected to participate in all the course activities and have a minimum of 70% attendance to be able to write the final examination

READING LIST:

Entomology and Pest Management by Larry Pedigo

LECTURE NOTES

Economic entomology is a field of entomology, which involves the study of insects that are of benefit or those that cause harm to humans, domestic animals, and crops. Only a few insects are pests, many insects are beneficial to man.

Economic importance of insects:

a. collect, elaborate and store plant products e.g horny bee
b. spin cocoon e.g. silkworm
c. secrete resinous substances called ‘lac’ used in the manufacture of gramophone records, paints, varnishes and for colouring toys e.g. lac insects
d. Some dyes such as cantharidin and cochineal are collected from certain insect bodies
e. Used as fish baits

f. Produce galls on the plants; the galls contain tannic acid and used for tanning leather
g. Help in improving soil fertility
h. Scavengers
i. Food source
j. Pollinators
k. Natural enemies of crop pests
l. Aesthetic and entertainment value
m. Scientific experiments e.g. *Drosophila melanogaster*

Harmful insects: attack

a. Growing crops
b. Stored produce
c. Household structures
d. Man and animals

Management of harmful insect

- To increase food production
- To improve health
- For aesthetics
- Social reasons

Definition of Pest

A pest is any form of plant or animal life or any pathogenic agent injurious or potentially injurious to plant, plant products, livestock, and man

Principles of insect pest management

a. Exclusion:
b. Avoidance:
c. Protection:
d. Resistance:
e. Therapy

History of pest management

Chemical pesticides date back 4,500 years, when the Sumerians used sulfur compounds as insecticides. The Rig Veda, which is about 4,000 years old, also mentions the use of poisonous plants for pest control. It was only with the industrialization and mechanization of agriculture in the 18th and 19th century, and the introduction of the insecticides pyrethrum and derris that chemical pest control became widespread. In the 20th century, the discovery of several synthetic insecticides, such as DDT, and herbicides boosted this development. Chemical pest control is still the predominant type of pest control today, although its long-term effects led to a renewed interest in traditional and biological pest control towards the end of the 20th century.

Methods of pest control

Physical control: elimination of pests through physical means

a. Collection and destruction of pests
b. Use of traps
c. Burning
d. Use of inert dusts
e. Flooding
f. Manipulation of temperature and humidity
g. Gamma radiation

Cultural control: oldest traditional method of control

a. Selection of good site: empirical observation will reveal that certain areas of field are constantly at risk
b. Use of clean plant materials: planting of insect-free materials would prevent insect development

c. Deep sowing: Sowing of certain seeds deep into the soil can reduce insect infestation
d. Deep ploughing: Ploughing exposes the various stages of insect to sunlight and natural enemies
e. Manipulation of planting time: Peak population of pests may be avoided by planting early or late depending on the biology or ecology of the pests involved
f. Manipulation of harvesting time: Prompt harvesting may prevent insect pests from infesting crops
g. Crop sanitation: this includes destruction of diseased or badly damaged plant, removal and destruction of old crop residues, fallen leaves, branches, dead trunks, weeds, etc, removal or destruction of fallen fruits, destruction of crop residues.
h. Crop rotation: Susceptible crops must not follow another one in a row.
i. Plant density and spacing: closely planted crops may provide shade for certain insect pests.
j. Intercropping: non-host crops should be mixed with hosts
k. Use of trap crops
l. Use of mulches
m. Close season

Biological Control

-Purposeful manipulation of the natural enemy to suppress, decimate the population of a pest.

Agents of biological control

a. Parasite: are microorganisms that inhibit pests in certain ways thus reducing the efficiency of the pest.
b. Pathogen: are also microscopic in nature but are different from parasites in that they cause a disease condition before the host is killed
c. Parasitoids: parasites that have destructive biology. They lay eggs on or close to the host, and when the eggs hatch, the obtain water and nutrients from the host thereby killing the hosts.
d. Predator: They are natural enemies that seize their preys and kill them.
e. Competitor: competitively displace pest species

Methods of Biological control:

a. Conservation
b. Augmentation
c. Introduction

Considerations for biological control

a. Economic consideration: Economic threshold must be established for the crops involved. It must also increase crop production
b. Ecological consideration: Annual agro ecosystem is not ideal for biological control.

Ecological considerations include the following:

Nature of pests (whether they are sedentary, aggregate, relatively exposed, pests of perennial crops

Nature of infestation: single or multiple infestations

Characteristics of a good natural enemy:

Aggressiveness, good searching ability, must be discriminatory enough, specificity, high reproductive ability.

Host plant Resistance

It is the relative amount of heritable qualities possessed by a plant which influence the ultimate degree of damage done by insects in the field.

Types of resistance/mechanism of resistance

a. True and false resistance
    1. antixenosis
    2. antibiosis
    3. tolerance
b. False resistance

1. Host evasion
2. Host escape
3. Induced resistance

Legislative control

It is the enactment of legislation to prevent the introduction and /or further spread of pest organism in an area. Sometimes, drastic preventive measures are necessary to checkmate incidence of a pest from gaining entry into a country.

a. Legislation to prevent introduction of foreign pests
b. Legislation to prevent spread of pest after entry
c. Legislation to enforce the application of effective control measures
d. Legislation to prevent to set up surveillance system
e. Legislation to license pesticide
f. Legislation to prevent adulteration or mis-branding of pesticides
g. Legislation to regulate the act of men engaged in pest activity

Procedure for legislative control at the port

- Inspection
- Detection
- Quarantine
- Sorting
- Interception
- Eradication
- Prohibition
- Treatment or remedy

Chemical control: is the use of chemical pesticides to kil, destroy, attract, repel or outright decimation of a pest population. The old concept of chemical control was outright killing of pests, but now there are pesticides that do not necessarily kill their targets, but attract, repel or prevent their feeding; all thee are also called pesticides.

Advantages of Pesticides

a. they are active
b. readily available
c. cheap

Disadvantages

a Development of resistance: After exposures to pesticides, many pests are able to adapt to pesticides so that higher doses or combinations would be required to control them

b Outbreak of secondary pests: Natural enemies of minor pests are killed along with target key pests. The minor or potential pests may develop to key status in the absence of their natural enemies.

c. Resurgence of sprayed pests: Natural enemies are more susceptible to pesticides than the target pests themselves. Sprayed pests could re-build their population after their natural enemies have been killed.

d. Toxic residues: Pesticides leave toxic residues in foods

e. Health hazards: Pesticides use pose direct risk to field operators, domestic users and non-users

f. Loss of soil fertility: When pesticides get into the soil, they kill beneficial soil organisms thereby causing loss of soil fertility

Types of pesticides

Pesticides can be categorized based on several criteria such as: route of entry, formulation, origin, selectivity, point of contact, time of application etc.

Classification based on parent chemical (inorganic and organic)

a inorganic: These group lack carbon atoms in their molecules. They are toxic by ingestion; mode of action is stomach. They are toxic man, they have persistent residues e.g. arsenates, elemental sulphur.

b. Organic compounds: Have carbon atoms in their molecules.
   i. Botanicals: derived from plants
   ii. hydrocarbon oils
   iii. synthetic organic insecticides

Synthetic organic insecticide could be classified into (a). organochlorines (b). organophosphates (c) carbamates (d) botanical analogues (e) hormone derivatives

STERILE INSECT TECHNIQUE

This is the employment of genetically impaired pest species to control or destroy its own kind or bring about self destruction of its own species. It is also called 'autocidal control' (self-killing) or genetic control. In SIT, a large population of laboratory bred and artificially sterilised male is released into an environment to outnumber the local males. When they mate with the local females, the offspring produced will not be viable.

Conditions necessary for the application of SIT

a. it must be against isolated pests
b. can be used against isolated pests when reach low point in their density cycle
c. against newly introduced pests

Conditions necessary for success of SIT

- area-wide programme must be imposed
- insect rearing facility
- there must be ecological barrier such as mountains, oceans etc
- sterilization of the insect must be dome without affecting vigour and mating competitiveness
- sterilization must not alter the morphology of exposed insects

Advantages and disadvantages of SIT

Integrated pest management (IPM) is an integrated approach of crop management to solve ecological problems when applied in agriculture.

These methods are performed in three stages: *prevention*, *observation,* and *intervention*. It is an ecological approach with a main goal of significantly reducing or eliminating the use of pesticides while at the same time managing pest populations at an acceptable level.

An IPM system is designed around six basic components:

Acceptable pest levels: The emphasis is on *control*, not *eradication*. IPM holds that wiping out an entire pest population is often impossible, and the attempt can be economically expensive, environmentally unsafe, and frequently unachievable. IPM programmes first work to establish acceptable pest levels, called action thresholds, and apply controls if those thresholds are crossed. These thresholds are pest and site specific, meaning that it may be acceptable at one site to have a weed such as white clover, but at another site it may not be acceptable. By allowing a pest population to survive at a reasonable threshold, selection pressure is reduced. This stops the pest gaining resistance to chemicals produced by the plant or applied to the crops. If many of the pests are killed then any that have resistance to the chemical will form the genetic basis of the future, more resistant, population. By not killing all the pests there are some un-resistant pests left that will dilute any resistant genes that appear.

1. **Preventive cultural practices:** Selecting varieties best for local growing conditions, and maintaining healthy crops, is the first line of defense, together with plant quarantine and 'cultural techniques' such as crop sanitation (*e.g.* removal of diseased plants to prevent spread of infection).
2. **Monitoring:** Regular observation is the cornerstone of IPM. Observation is broken into two steps, first; inspection and second; identification. Visual inspection, insect and spore traps, and other measurement methods and monitoring tools are used to monitor pest levels. Accurate pest identification is critical to a successful IPM program. Record-keeping is essential, as is a thorough knowledge of the behavior and reproductive cycles of target

pests. Since insects are cold-blooded, their physical development is dependent on the temperature of their environment. Many insects have had their development cycles modeled in terms of degree days. Monitor the degree days of an environment to determine when is the optimal time for a specific insect's outbreak.

3. **Mechanical controls:** Should a pest reach an unacceptable level, mechanical methods are the first options to consider. They include simple hand-picking, erecting insect barriers, using traps, vacuuming, and tillage to disrupt breeding.
4. **Biological controls:** Natural biological processes and materials can provide control, with minimal environmental impact, and often at low cost. The main focus here is on promoting beneficial insects that eat target pests. Biological insecticides, derived from naturally occurring microorganisms (*e.g.*: *Bt*, entomopathogenic fungi and entomopathogenic nematodes), also fit in this category.
5. **Responsible Pesticide Use:** Synthetic pesticides are generally only used as required and often only at specific times in a pests life cycle. Many of the newer pesticide groups are derived from plants or naturally occurring substances (*e.g.*: nicotine, pyrethrum and insect juvenile hormone analogues), but the toxophore or active component may be altered to provide increased biological activity or stability. Further 'biology-based' or 'ecological' techniques are under evaluation.