Debre Berhan University

College of Agriculture and Natural Resource Science

Department of Plant Science

Graduate Program: Master of Science in Plant Protection

November, 2017

Debre Berhan University
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1. Introduction

1.1. General background

The agricultural sector greatly influences economic performance in Ethiopia. With a total area of about 1.13 million km^2 and about 51.3 million hectares of arable land, Ethiopia has a great potential for agricultural development. However, only about 11.7 million hectares of land (22.8%) is currently under cultivation. Smallholder farming is the dominant agriculture (NFSAP, 2013). The agricultural sector employs nearly 80% of the economically active population, contributing about 43% of the Gross Domestic Product (GDP) and 90% of total export earnings of the country. Coffee, pulses, and oil seeds constitute about 90% of total export earnings of the country.

The country has a great diversity of climates, soil types and vegetation. The variability in environmental factors has an important implication on the variety of plants in the country. The elevations provide for temperature differences for growing several kinds of crops. A wide variety of crops are found growing in various parts of the country. In the highlands, where cool temperature prevails, common temperate crops are grown. Many tropical and sub-tropical crops are also grown in low to mid altitudes of the country. The country is a center of origin and/or diversity for many plant species including several cultivated crops, such as coffee, sorghum, "teff", durum wheat, finger millet, barley, "noug", safflower, sesame, castor bean, faba bean, etc.

The agricultural sector is, however, plagued by several natural and anthropogenic factors. Periodic drought coupled with rapid population growth and consequent land degradation threatens to reduce the productivity of agriculture and increase vulnerability to drought, which has often wiped out 90% of agricultural production. Over 80% of the population resides in rural areas and remains largely dependent on rain-fed agriculture, Pre and post-harvest losses (estimated between 10-15%), diseases, insect pest, weeds, nematodes and poor marketing system further undermine incentives to increase productivity. Current crop production and productivity of the country in general can be reversed and increased through the use of improved production technologies, reduction of pre- and post-harvest crop losses, and efficient use and proper management of natural resources. This can be attained if and only if an adequate number of well-

trained and qualified human resources is involved in all processes of technology generation, dissemination and development.

1.2. Mission of the department

The ultimate mission of Department of the Plant Sciences enhancing the country's sector of agricultural economy at large and the crop farming enterprise in particular. It attempts to carry out its mission by producing concerned and dedicated citizens who are trained and qualified to assume responsibilities and properly execute the duties to the maximum of their ability to fulfill the needs of their employer organization in particular and to the country in large.

1.3. Rationale of the program

Despite of its high potential of crop production, the country is facing the problems of food shortages and cash crops; and hence has not been able to achieve food security and self-sufficiency to feed its ever-increasing population. Crop yields have remained low, although research results show that there is tremendous potential to increase production and productivity. Low production and productivity mainly attributed to limited access by smallholder farmers to agricultural inputs, improved production technologies, and more importantly, declining soil quality due to poor land management practices and poor marketing system. Therefore, due attention should be given to the development of skilled and competent professionals in order to advance the agricultural sector in a sustainable, environmentally friendly and socially inclusive manner. The need for well-trained and adequately qualified professionals in Plant Protection is highly crucial in order to beat the considerable productivity potential of the agriculture sector through resource conservation.

Since its inauguration in 2007/2008 G.C under the College of Agriculture and Natural Resources Science, the Department of Plant Science has been making its effort in realizing the vision of Debre Berhan University, through offering the teaching-learning, conducting researches and community services. The Department has been producing professionals on crop production/protection areas at undergraduate level in both Regular and Post graduate admissions respectively. Currently, considering its staff profile, available resources and the demand of stakeholders, the Department

of Plant Sciences planned to launch the postgraduate studies in Plant Protection program (at M.Sc. level).

Results of the need assessment (which was carried out by College of Agriculture and Natural Resources, Plant Sciences staffs) also confirmed the relevance of the proposed program. Accordingly, the overall results of the assessment shown the opening of the Plant Protection program will have a paramount importance for the development of the agricultural sector.

In general, there is an increasing demand from the stakeholders and the country at large for trained/highly-qualified and skilled professionals to tackle the multifaceted problems in agricultural sector. Therefore, this postgraduate program – Plant Protection - is designed to respond to immediate needs of the country to increase crop protection and productivity, and thereby contribute to improve the livelihood of the people.

1.4. Objectives of the program

The overall aim of the postgraduate program is to produce competent professionals who are equipped with both theoretical and practical knowledge and skills in all aspects of crop protection/management; and capable of conducting various researches and extension activities which can contribute to ensuring food security and self-sufficiency of the country. The program will engage in training, research and community service activities related to the crop protection subsector who can play a key role in the production, productivity and quality of food/feed/fiber crops.

The specific objectives of the graduate program are to:

- enable graduates to acquire an in-depth theoretical knowledge and practical skills in climate-smart crop production and management system;
- provide demand-driven training and build the capacity of manpower that will contribute to generation, dissemination and adoption of improved production and protection technologies and thereby contribute to the intended regional and national development;
- produce well-trained high level professionals who are capable of conducting of identifying, designing and implementing problem-solving research projects related to agricultural sector;

- integrate training-research-extension to increase the efficiency of plant technology generation, dissemination and adoption by end-users and, thereby, contribute to the agricultural development of the country;

2. Graduate profile and competencies

2.1. Graduate profile

Graduates of the Plant Protection program will be qualified professionals who are well-acquainted with scientific knowledge; skills and attitude that enable them to:

- Identify and analyse problems related to crop protection and management and devise appropriate solutions towards self-sufficiency and food security.
- Promote and disseminate agricultural technologies through training of farmers and extension worker.
- Plan, implement, monitor and evaluate research projects related to crop protection and management in a sustainable basis.
- Assist policy-makers and development practitioners on appropriate and climate-smart crop production and management techniques.
- involve in consultancy and advisory services to private enterprises and entrepreneurs in relation to protection, management and marketing of economical crops and related fields;

2.2. Job opportunities

The graduates can serve as professionals of aforementioned areas, in various organizations such as:

- Ministry of Agriculture and Rural Development
- Regional Bureau of Agriculture and Natural Resources
- Federal and Regional Agricultural Research Institutes,
- Higher Learning Institutions/Universities
- Development-oriented non-governmental organizations

The graduate can serve in various capacities in the organizations mentioned above, to mention some of them:

- ☞ Researchers in the field of Crop protection, crops production and management
- ☞ Educators (instructor at both ATVET and University level)
- ☞ Experts in various crops production and management
- ☞ Managers in commercial farms, agro-processing and marketing agencies
- ☞ Consultant and/or advisor in the overall crop production and management aspects.

2.3. Admission requirements

In order to be considered for admission for Plant Protection program (including the admission requirements of DBU legislation), the candidate (applicant) must meet the following specific requirements:

- ☞ The candidate should be a graduate of BSc degree from an accredited university/college in Plant sciences, Crop sciences, Crop Production, Horticulture, General Agriculture, Biology, Ecology and related fields with mandatory of bridging courses or other related disciplines with cumulative grade point average (CGPA) of 2.00 and above
- ☞ The candidate must also pass the written entrance examination administered by the program.
- ☞ Unless he/she is self-sponsored, a graduate student shall present evidence of support from his/her respective sponsoring organization for his/her salary, travel cost and the cost for his/her thesis research project.

4. Duration of study and Enrollment:

4.1. Duration of study

The program will normally have two-year duration, with one semester consisting of 16 weeks. In the first year (two semesters) of the program courses are taught, while in the second year mainly the research thesis project is carried out. The minimum and maximum study duration for the program is in accordance to the DBU Legislation.

4.2. Enrollment

The program will mainly run as a regular program, however if the need arises, it can be offered as a summer program taking three summers, provided thesis work can be done outside the summer time.

5. Graduation requirements

Students are obliged to attend and pass courses of study, which are included in this document and add from undergraduate programs (if a student is deficient in a course and/or some courses). This program requires, beyond BSc degree, a minimum of 30 credit hours course work and 6 credit hours of thesis research. Undergraduate courses will not be counted as part of the students' graduate program. Students must also score a minimum of 3.00 cumulative GPA, with a maximum of one "C" grade in all courses for which they have been registered, and defended their thesis successfully. Accordingly, "C" grade is permitted for only one course, while all other scores of "C" or less need to be corrected through re-exam. All this will follow the DBU Legislation. No student will be able to defend a thesis before completing course requirements.

The thesis: for successful graduation with thesis research work in this program, a student should score at least a "*Satisfactory*" rating of the thesis research as stipulated in the university senate legislation

6. Degree nomenclature

The postgraduate program in Plant Protection leads to a degree certificate referred in English as "**Masters of Science in Plant Protection**", and in Amharic as **"ማስተሬት ዲግሪ በሰብል ጥበቃ".**

7. Medium of instruction

The medium of instruction for the program is "English"

8. Assessment and evaluation

8.1. Mode of delivery

Lectures, practical sessions, individual or group works, projects, experience sharing, laboratory and field demonstrations, self-directed assignments, guided readings and student presentations on variety of topics are the main recommended mode of delivery for the program.

8.2. Mode of assessment

Assessment for each course is not a one-step phenomenon, but it should be carried out as a continuous process throughout the course delivery. In general, assessment of learning outcomes should be made by the following method of assessment including: **mid-term and final semester written examinations** as well as student's presentation and communication skills, practical and laboratory exam, term papers/seminar papers (reviews and reports) depending on the nature of the course.

8.3. Grading system

Grading system in the program is fixed scale grading, and will be implemented in accordance with the legislation of DBU University. Hence, the summative assessment point will be graded using criteria referenced. Letter grades are assigned as indicated below:

Row mark range	Letter grade	Grade points
≥ 95	A^+	4.00
[90,95)	A	4.00
[85,90)	A^-	3.75
[80,85)	B^+	3.50
[75,80)	B	3.00
[70,75)	B^-	2.75
[65,70)	C^+	2.50
[58,65)	C	2.00
[50,58)	D	1.00
Below 50	F	0.00

Note: [a,b) = $a \leq x < b$

8.4. The research thesis evaluation

The thesis research accounts for 6 Credit hours. It is examined by external and internal examiners and chairperson. Both of them evaluate the thesis research out of 100% and an average weight will be taken for rating. Accordingly, average weight:

Evaluation mark range	Rating
>85	Excellent
[75,85)	Very Good
[60,75)	Good
[50,60)	Satisfactory
< 50	Fail

For successful graduation with thesis research work in this program, a student should score at least a "**Satisfactory**" rating of the thesis research as stipulated in the DBU legislation.

9. Student's advisory system

9.1. Postgraduate committee (DGC)

Members of the department graduate council (DGC) which consists of assistant professors and above in the department are responsible to oversee the overall implementation of the postgraduate programs in the department (as per DBU legislation) Within the DGC there is a postgraduate coordinator who will guide all the newly admitted students in the registration process. The coordinator will make sure that the students registered for courses in each semester according to the approved plan schedule.

9.2. Research advisors

A major advisor and/or co-advisor will be assigned to each postgraduate student at the end of the second semester of the first year by the DGC and approved by the Head of the Department.

9.2.1. Responsibilities of the advisors(major advisor and/or co-advisor)

- ☞ The advisors shall guide and supervise the student in all aspects of the thesis research (starting from proposal writing up to submission of final draft of the thesis).
- ☞ The advisors shall meet his/her students very frequently and keep in touch with their progress during informal meetings which can be in office or laboratory/field where the student is working.
- ☞ The advisor shall note that the title of the thesis when submitted should be the same as of the synopsis approved earlier. If any changes are required to be made, this should be done

with the permission of DGC of the Department, at least six months before the submission of first draft of the thesis.

- ☞ It is the duty of the advisors to guide the students regarding their day-to-day research activities to complete the degree well in time.

10. Course profile

10.1. Course coding system

The course code has four letters and three numbers. The letters "PlPr" indicate the name of the program (**Plant Protection**), while the three numbers indicate: the first number indicates the level of the course in terms of the year, which is a continuation of the undergraduate program; accordingly, '5' for 1st year and '6' for 2nd year. The middle digit represents the category of the course in the program (i.e. 1 for core specialization courses, 2 for supportive courses, 3 for elective courses and 4 for research courses). The third digit represents the semester in which the courses will be offered: (odd numbers for first semester and even numbers for second semester). No space is needed between the letters and the numbers: e.g. PrPr531.

10.2. Course breakdown

Table 1. Course Break down for Regular Plant Protection M.Sc. program; Semester I and II respectively.

Semester one(I)

No	Course code	Course title		
			Credit Hours	CP/ECTS
1	PlPr 511	Advanced Experimental Design	3(2+3)	
2	PlPr 521	Advanced Research Methods and Scientific Paper Writing	1(0+1)	
3	PlPr 531	Biology, Taxonomy and Ecology of Weeds	3(2+3)	
4	PlPr 541	Agricultural Bacteriology and Virology	3(2+3)	
5	PlPr 551	Morphology and Taxonomy of Insects	3(2+3)	
6	PlPr 561	Ecology of Insects	2(1+3)	

Total		**15 C.hrs**

Semester II

No	Course code	Course title	Credit Hours	CP/ECTS
1	PlPr 512	Agricultural Nematology	2(1+3)	
2	PlPr 522	Insect Physiology	3(2+3)	
3	PlPr 532	Integrated Pest Management	3(2+3)	
4	PlPr 542	Agricultural Mycology	2(1+3)	
5	PlPr 552	Host pathogen Genetics and Breeding for Resistance	2(1+3)	
6	PlPr 562	Agricultural Pesticide and environment	2(1+3)	
7	PlPr 572	Plant Disease Diagnosis and Development **(E)**	2(1+3)	
8	PlPr 582	Graduate seminar	1(1+0)	
9	PlPr 592	Post-harvest, pest and disease (E)	2(1+3)	
Total			**15/17C.hrs**	
10	PlPr 594	Thesis work	6	
Total		**30/36 ch.hrs**		

- ***E = Elective Courses, students are required to take at least one elective course.***

Table 2. Course Break down for Summer Plant Protection M.Sc. program; Semester I and II respectively.

Delivery time	Course code	Course name	Credit hours
Summer	PlPr 511	Advanced Experimental Design	3 (2+3)
	PlPr 531	Biology, Taxonomy and Ecology of Weeds	3(2+3)

I	PlPr 541	Agricultural Bacteriology and Virology	3(2+3)
Distance I	PlPr 551	Morphology and Taxonomy of Insects	3(2+3)
	PlPr 521	Advanced Research Methods and Scientific Paper Writing	1(0+1)
Summer II	PlPr 561	Ecology of Insects	2(1+3)
		Elective course	2
	PlPr 522	Insect Physiology	2(1+
	PlPr 532	Integrated Pest Management	3(2+3)
Distance II	PlPr 542	Agricultural Mycology	2(1+3)
	PlPr 512	Agricultural Nematology	1(1+3)
Summer III	PlPr 552	Host pathogen Genetics and Breeding for Resistance	2(1+3)
	PlPr 562	Agricultural Pesticide and environment	2(1+3)
Distance III	PlPr 594	Thesis work	6
	PlPr 582	Graduate seminar	1(0+1)
Summer IV	PlPr 594	Thesis work	6
		Total	**30/36**

Table 3. Course break dawn for Extension M.Sc. Plant Protection programme

Year	**Semester**	**Course code**	**Course name**	**Credit hours**
Year I	I	PlPr 511	Advanced Experimental Design	3(2+3)
		PlPr 531	Biology, Taxonomy and Ecology of Weeds	3(2+3)
	II	PlPr 541	Agricultural Bacteriology and Virology	3(2+3)

		PlPr 551	Morphology and Taxonomy of Insects	3(2+3)
	Summer	PlPr 521	Advanced Research Methods & Scientific Paper Writing	1(1+0)
		PlPr 561	Ecology of Insects	2(2+3)
Year II	I		Elective course	2(2+3)
		PlPr 522	Insect Physiology	2(2+3)
		PlPr 512	Agricultural Nematology	1(1+3)
	II	PlPr 532	Integrated Pest Management /***Pest Management***	3(2+3)
		PlPr 542	Agricultural Mycology	2(1+3)
	Summer	PlPr 562	Agricultural Pesticide and environment	2(1+3)
		PlPr 552	Host pathogen Genetics and Breeding for Resistance	2(1+3)
Year III	I	PlPr 582	Graduate seminar	1(0+1)
		PlPr 594	Thesis work	6
	II	PlPr 594	Thesis work	6
			Total	**30/36**

11. Course contents [[course description]]

Program	Plant Science
Degree program	M.Sc. in Plant Protection
Instructor	TBA
Course title	Advanced Experimental Design
Credit hours	3 (2+3)
Course code:	PlPr 511

Course Objectives

The main focus of this course is to equip students with fundamental principles and practical skills required for planning, execution, analysis and interpretation of scientific experiments using various designs. The course would also enable students to relate theoretical principles with real

biological phenomena that could be observed in the field, and exercise the proper use of statistical procedures and methods as tools for scientific decision making based on research data.

Thus, at the end of this course the learner will be able:

- To demonstrate the core concept of the principles of biometrical methods;
- To understand the importance and necessity of statistical methods in biological research;
- To choose appropriate statistical techniques for data analyses in common research situations;
- To design and analyze laboratory, glasshouse and field experiments; and
- To correctly interpret statistical results as a tool to answer biological questions.

Course Contents:

1. INTRODUCTION

1.1. Definition and Brief History of Biometry

1.2. Definition of Some Basic Terms

2. STATISTICAL INFERENCE

2.1. Estimation

1.2.1. Properties of best estimates

1.2.2. Confidence Interval

2.2. Hypothesis Testing

2.2.1. Types of hypothesis and errors in hypothesis testing

2.2.2. One- tailed and two-tailed tests

2.2.3. Test of a single population mean

2.2.4. Test of the difference between two means

2.2.5. Test of a proportion (percentage)

2.2.6. Test of population variances

3. PRINCIPLES OF EXPERIMENTAL DESIGN

3.1. Introduction

3.2. Design of Experiments

3.3. Concepts Commonly Used in Experimental Design

3.3.1. Treatments, Experimental Unit & Experimental Error

3.3.2. Replication

3.3.3. Randomization

3.3.4. Local Control

3.4. Analysis of Variance

3.4.1. General procedures in analysis of variance

3.4.2. Assumptions underlying the analysis of variance

4. COMPLETELY RANDOMIZED DESIGN (CRD)

4.1. Uses, advantages and disadvantages

4.2. Randomization and layout

4.3. Analysis of variance of CRD with equal replication

4.4. Analysis of variance of CRD with unequal replication

5. RANDOMIZED COMPLETE BLOCK DESIGN (RCBD)

5.1. Uses, advantages and disadvantages

5.2. Randomization and layout

5.3. Analysis of variance of RCBD

5.4. Block efficiency

5.5. Missing Data in RCBD

6. LATIN SQUARE DESIGN

6.1. Uses, advantages and disadvantages

6.2. Randomization and layout

6.3. Analysis of variance

6.4. Relative efficiency

6.5. Missing data

7. COMPARISON OF TREATMENT MEANS

7.1. Least Significant Difference (LSD) Test

7.2. Duncan's Multiple Range Test (DMRT)

7.3. Tukey's Test

7.4. Pair Comparisons with Missing

8. FACTORIAL EXPERIMENTS

8.1. Simple Effects, Main Effects and Interaction

8.2. Two Factor Factorial in CRD

8.3. Two-Factor Factorial in RCBD

9. SPLIT-PLOT DESIGN

9.1. Uses, advantages and disadvantages

9.2. Randomization and layout

9.3. Analysis of variance

9.4. Missing data

10. Regression and Correlation Analysis

10.1. Types of Regression and Correlation

10.2. Simple Linear Regression and Correlation Analysis

10.2.1. Simple linear regression analysis

10.2.2. Simple linear correlation analysis

10.3. Application of different software used in agricultural research

2. Teaching and Learning Method

In the practical sessions, students will make layouts for the different experimental designs and will have practical exercises on statistical software. In the class, the mode of delivery of the course combines lectures, practical activities, discussion, questioning and answering, readings, assignments, individual and/or group works and presentation. In addition, homework assignments will be given to help reinforce some topics covered or not covered in class

3. Assessment Methods

Evaluation will be carried out based on relevant tests, assignments, practical works, mid-exam and final examination as mention hereunder.

1. Home take assignments on different designs	20%
2. Mid Exam	20%
3. Practical works	20%
4. Final Exam	40%
Total	100%

4. **References:**

:

1. Gomez, K.A. and A.A. Gomez, 2010. Statistical procedures for agricultural research, 2nd edition. John Wiley & Sons Inc., New York. 680 pp.
2. Mead, R.N. Curnow and A.M. Hasted. 1993. Statistical methods in agriculture and experimental biology. 2nd edition. Chapman and Hall, London
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9. Montgomery, D.C. 2001. Design and Analysis of Experiments. John Wiley & Sons.
10. Petersen, R. 1994. Agricultural Field Experiments: Design and Analysis. Marcel Dekker, Ink. New York.
11. Quinn, G. & M. Keough. 2002. Experimental Design and Data Analysis for Biologists.Cambridge University Press

Department	Plant Science
Degree program	M.Sc. in Plant Protection
Instructor	
Course title	Plant bacteriology and virology
Credit hours	3(2+3)
Course code:	PlPr 541

1. **Course objectives:**

- To become familiar with current taxonomy of plant pathogenic bacteria and their important diseases.
- To become familiar with techniques for manipulating bacteria such as isolation, identification and inoculation of pathogens.
- To gain the knowledge of different pathogenic mechanisms used by different groups of major bacterial pathogens.

- To understand the ecology of various plant pathogenic bacteria and bacterial disease management strategies.
- To become familiar with the techniques of plant virus isolation, purification and characterization
- To understand the plant virus classification, genome organization and virus replication
- To have knowledge of ways of plant virus transmission
- To develop the academic ability to critically review research articles about biological/agricultural sciences.

Course outline:

Part One: Bacteriology

1. **Introduction to bacteriology and bacteria**
2. Notes on the history of bacteriology
3. Place of bacteria in the living world
4. Morphology of bacteria
5. Physiology and growth of bacteria
6. Metabolism of bacteria
7. Molecular biology and genetics of bacteria
8. Genetic exchange between bacteria
9. Taxonomy of bacteria

2. Phytobacteriology and diagnosis of bacterial diseases of plants

1. Notes on the history of phytobacteriology
2. Phytopathogenic bacteria , symptoms of diseases
3. Diagnosis of bacterial plant diseases

a) Assessment of symptoms

b) Isolation

c) Pure culture

d) Detection and identification

- Conventional detection methods
- Conventional identification methods
- Newer detection methods
- Newer identification methods

e) Pathogenicity test

f) Reisolation
g) Reidentification
h) Diagnosis report

3. Disease and symptoms caused by plant pathogenic bacteria

1. The pathogenic bacterium
2. The host plant
3. Molecular basis for interaction between a pathogenic bacterium and a (non-) host: pathogenicity, virulence, HR reaction and resistance
4. Phases in pathogenesis
5. Symptoms
    a. Leaf spots
    b. Excrescences and galls
    c. Tumours
    d. Vascular disease and wilting
    e. Necroses and cankers
    f. Rotting
    g. Bacteria embedded in slime
    h. Symptoms of fastidious, non culturable bacteria, including *Xylella fastidiosa*, phytoplasmas and piroplasmas

4. Epidemiology

1. Environmental effects and disease development
2. Survival
3. Dissemination and transmission of the pathogen and epidemiological cycles
4. Geographical distribution of some bacterial pathogens

5. Damage and losses caused by bacterial plant diseases

1. Damage
2. Losses

6. Prevention and control of bacterial pathogens and diseases

1. Principles of control of plant pathogenic bacteria and/or the diseases they cause
2. Prevention of introduction and dispersal after interception of bacterial plant pathogens by quarantine measures and legislation
3. Control aimed at eradication
4. Prevention and control at farm or nursery level: the integrated approach
5. The role of education and hygiene
6. The role of healthy basic material and indexing/testing in control strategies
7. Breeding for resistance
8. Biological control
9. Chemical control
10. Sanitation and disinfection

7. Examples of bacterial diseases of cultivated and wild plants

1 Palm trees
2 Orchids
3 Arable and cash crops
4 Fruit and nut trees
5 Ornamental plants
6 Stone fruits
7 Vegetables
8 Bacterial pathogens that attack many host plants

Part Two Virology

1. Plant Virology introduction
2. History of Plant Virology
    - Viruses and organisms confused with viruses
3. Plant virus Symptoms
    - Macroscopic Symptoms
    - Systemic symptoms
    - Mosaic patterns and related symptoms

- Necrotic diseases and abnormalities of plants

4. Nomenclature & Classification of Plant Viruses
5. Plant Virus Isolation, Purification and Characterization
6. Plant virus Transmission
    - Types of plant virus transmission
    - Methods of transmission
    - Factors affecting mechanical transmission
    - Vegetative & Graft Transmission
    - Dodder transmission
    - Insect transmission
    - Terminology use in virus transmission
7. Plant virus genome organization
8. Plant Virus replication
9. Phytoplasmas and Viroids

3. Evaluation

The Evaluation will be carried based on relevant tests, assignments, seminar and laboratory works and final examination

SUMMARY OF COURSE ASSESSMENT

5. Home take assignments, term paper	20%
6. Mid Exam	20%
7. Lab report and practical exam	10
8. Final Exam	50%
Total	100%

Grading: - As per the university's regulation

4. References

1. Agrios, G.N. 2005. Plant Pathology (5th eds) New York: Academic Press.
2. Janse, J. D.2005, Phytobacteriology principles and practice, CABI Publishing, London, UK.
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Department	Plant Science
Degree program	M.Sc. in Plant Protection
Instructor	
Course title	Weed Biology, Taxonomy and Ecology
Credit hours	3(2+3)
Course code:	PlPr 531

Course objectives: -

Students will be able to: -

- Identify the different types of weeds and their effect on crop performance
- Gain an understanding of the biological and ecological factors affecting the distribution, abundance, persistence and dynamics of weed species and population
- Become familiar with the principles of herbicide classification and application technologies
- Become familiar with the principle of weed control strategies
- Apply weed biology and ecology concepts towards improved weed management
- Understand herbicide modes of action and the evolution of resistant weeds
- Gain basic and applied knowledge on the safe and rational use of herbicides
- Analyse management of weed using an integrated weed management approach

Course Description:

The course is designed to introduce students to the basic scientific principles understanding of weed, weed identification/classifications ; emphasis is on the ecology: dissemination and survival mechanism and biology of weeds: general reproduction systems , weed control practices in cereal and horticultural crops, preventive, physical, chemical, biological; integrated weed management , control in crop associations , herbicides, herbicides classification, factors affecting herbicide application, safety rule of herbicide application: formulation, handling, storage, use and disposal; Calibration of application equipment and calculation of rates.

Course Outline:

1. Introduction

1.1 Definitions of weeds

1.2 Reasons for classifying a plant as a weed

1.3 Common Characteristics of weeds

1.4 Harm effects of weed

1.5 Economic importance of weeds

2. Classification of Weeds

2.1 Classification methods

2.1.1 Types of Plant

2.1.2 Based on Habitat

2.1.3 Based on Life history

2.1.4 Based on their cotyledons

2.1.5 Based on nature of their stem

2.1.6 Based on origin of weeds

3. Weed Biology

3.1 Weed reproduction through sexual and asexual

3.2 Dispersal of Weeds

3.3 Persistence of Weed

3.4 Weed seed bank

3.5 Importance of weed biology

4. Weed Ecology

4.1 Autecology

4.2 Synecology

4.3 Ecological succession of weed

4.4 Crop-Weed association

4.5 Importance of weed ecology

5. Weed-Crop Competition

5.1 Weed Competition for Growth Factors

5.2 Competition for Moisture

5.3 Competition for light (Solar energy)

5.4 Competition for space

5.5 Threshold of competition

5.6 Critical Period of Weed Crop Competition

6. Methods of weed management and control

6.1 Weed management practice

6.1.1 Prevention methods

6.1.2 Eradication methods

6.2 Mechanical methods

6.3 Biological methods

6.4 Cultural methods

6.5 Chemical methods

7. Herbicides

7.1 Herbicides and other pesticides

7.2 Herbicides classification

7.3 Common herbicides

7.4 Mode of actions of herbicides

7.5 Herbicide mixture/combination

7.6 Periods and ways of application of herbicides

7.7 Rates of use of the active ingredient and the solvent

8. Herbicide Formulation

8.1 Liquid formulations

8.2 Solid formulations

8.3 Others

Lab and Practical sessions: -

- Field weed sample collection and preservation
- Weed survey and population determination; frequency, abundance dominance and community index
- Weed identification and observation
- Seed production by crop and weed seedlings- collection and preservation of weed seeds
- Demonstrations of methods used for the estimation of soil weed seed bank
- Assessment of the effect of different weed factors on weed competition
- Evaluation of the effectiveness of different weed control methods
- Herbicide Formulation and Dosage calculations
- Yield loss assessment due to weeds
- Herbicide injury symptoms observation
- Observation on the effects of different herbicides on weeds; contact and translocative, selective and nonselective.
- Slide / video show

Prescribed Literature

Aldrich, R.J. & R.J. Kremer. 1997. Principles in Weed Management. Second Edition. Iowa State University Press, Ames, Iowa. 455 p.

Alstrom S. 20034. Fundamentals of Weed Management in Hot-Climate Peasant Agriculture. Universal Scientific publishers. 271 p.

Anderson, W.P. 1996. Weed Science: Principles and Applications. Third Edition. West Publishing, Minneapolis/St.Paul. 388 p.

Ann Stroud and Chris Parker. A Weed Identification Guide for Ethiopia. 278 p. Original Book.

Buhler, D.D. 1999. Expanding context of weed management. Food Products press, New York, London.

Chris Parker and …1997. Biology and management of parasitic weeds in the world.

Gupta 2001. Weed Management: Principles and Practices. Agrobios, India. 269 p

Gupta, O.P. 2002. Modern Weed Management. Agrobios (India). 489 p.

Julien, M.H. and Griffiths, M.W. 1998. Biological Control of Weeds. A World Catalogue of Agents and their Target Weeds. Fourth Edition. CAB International, Wallingford, UK. 223p

METHODS OF EVALUATION

1. **Homework:** Homework assignments will be given to help reinforce some topics covered or not covered in class.
2. **Term paper:** All students will be required to complete literature review based papers to successfully complete this course.
3. **Presentation:** All students will be expected to present the term paper prepared in group to familrize for presentation, questions, reactions, discussion and others in the class
4. **Laboratory reports / field reports**
5. **Examination**

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 15%

Presentation ---------- 5%

Lab/field reports ----------15%

Mid Exam ----------20%

Department	Plant Science
Degree program	M.Sc. in Plant Protection
Instructor	
Course title	Morphology and Taxonomy of Insects
Credit hours	3(2+3)
Course code:	PlPr 551

Course Description: Insect taxonomy means the insect evolution and classification up to class insecta and phylum Arthropoda, and the insect morphology means the study of structures and features of insect body. The entire course will include introduction and origin of insects; history-evolution of Entomology; characteristics of phylum Arthropod and categories of insect pests; structures and features of insect body; the course will equip the students with detail knowledge of insect taxonomy and morphology as follow.

(a) Insect Taxonomy: Introduction, class insecta and its position in phylum Arthropoda, history of insect classification and evolution; methods of collecting and preserving insects; classification of insects up to orders; taxonomic collection and processes of identification.

(b) Insect Morphology: Body wall structure, cuticular outgrow/colouration, special integumentary structures and modifications, sense organs; body regions like sclerites and segmentation; head-types of mouth parts and antennae (structure and types); thorax: pro-thorax, meso-thorax and meta-thorax; legs and locomotion; wings-modification of the wings and venation, coupling, mechanisms and movements of the wings; abdomen–structure abdominal appendages both in pterygota and apterygota; external genitalia: general structure.

Course objective: The objective of the course is to teach students about insect taxonomy and morphology which will include introduction and origin of insects; history and evolution of Entomology; characteristics of phylum Arthropod and categories of insect pests; structures and features of insect body; the practical work on insect taxonomy and morphology activities will be done under laboratory and field.

TENTATIVE SCHEDULE OF LECTURE TOPICS AND READING

Week	Conceptual Focus		References
1	CHAPTER-1	(a) Insect Taxonomy: Agricultural Entomology and Agri-Biodiversity	Duntson P.A. (2004) and Elzinga, R.J. (1987)
	CHAPTER-2	History of Entomology	„
2	CHAPTER-3	Insect Evolution and Fossil Insects	„
	CHAPTER-4	Geological Evolution of Insects	„
3	CHAPTER-5	Insect position in phylum Arthropoda	„
	CHAPTER-6	History of Classification of Insects and Phylogeny	„
4	CHAPTER-7	Insect Classification up to Orders, etc.	„
	CHAPTER-8	Main features and characters of Orders Blattodea and Mantoda	„
5	CHAPTER-9	Thysanoptera	„
	CHAPTER-10	Neuroptera	„
6	CHAPTER-11	Odonata	„
	CHAPTER-12	Isoptera	„
7	CHAPTER-13	Hemiptera	„

	CHAPTER-14	Diptera	„
8	CHAPTER-15	Coleoptera	„
	CHAPTER-16	Lepidoptera	„
9	CHAPTER-17	Hymenoptera	„
	CHAPTER-18	Principles of Identification Keys	„
10	CHAPTER-19	Methods of Collecting and Preservation of Insects	„
	CHAPTER-20	Economic importance of insect	„
11	CHAPTER-21	**(b) <u>Insect Morphology</u>:** Body wall structure, cuticle outgrow, colourations,	„
	CHAPTER-22	Special integumentary structures and sensory organs	„
12	CHAPTER-23	Body regions like sclerites and segmentation	„
	CHAPTER-24	Head: mouth parts (structure and types), antennae (structure and types), eyes and ocelli	„
13	CHAPTER-25	Prothorax, mesothorax and metathorax	„
	CHAPTER-26	Types, structure and locomotion of legs	„
14	CHAPTER-27	Wing venation, modification and coupling	„
	CHAPTER-28	Wing mechanisms and movements	„
15	CHAPTER-	Abdominal sutures and appendages in Pterygota	„

	29	and Apterygota and External Genitalia	
	CHAPTER-30	Abdominal sutures and appendages in Pterygota and Apterygota and External Genitalia	„

N.B. 1. The content will be updated every year from different web sites

2. Handout will be distributed for this chapter

Practical in Insect Taxonomy and Morphology

Description for Practical Sessions

Students will be guided to do practical work on recognition of harmful and beneficial insects; their morphology like body regions - head, thorax and abdomen; body parts like mouth parts, eyes, ocelli, antennae, legs, wings, abdominal sutures, appendages and external genitalia; insect classification up to Orders; field collection of insects, identify and classify them into various Orders; insect mounting, stretching, drying and preserving them in Insect Collection Boxes.

TENTATIVE SCHEDULE OF PRACTICAL SESSIONS

Week	Practical Work	Assignment
1	Identifying Insect Body Regions and Parts: Head, Thorax and Abdomen; Mouth parts (Types and Structures), Antennae (Types and Structures) and Ocelli	Report writing
2	Thorax: prothorax, mesothorax and metathorax; Legs (Types and Locomotion); Wings venation, modification, coupling, mechanisms and movements	Report writing
3	Abdominal sutures, appendages and external genitalia	Report writing
4	Study and identification of major insect Orders: Blattodea and Mantoda	Report writing
5	Odonata and Isoptera	Report writing

6	Thysanoptera and Neuroptera	Report writing
7	Hemiptera	Report writing
8	Diptera	Report writing
9	Coleoptera	Report writing
10	Lepidoptera	Report writing
11	Hymenoptera	Report writing
12	Field visits to collect insects, pin, stretch, dry and preserve them in Insect Collection Boxes	Report writing

METHODS OF EVALUATION

1. **Homework:** Homework assignments will be given to help reinforce some topics covered or not covered in class.
2. **Term paper:** All students will be required to complete literature review based papers to successfully complete this course.
3. **Presentation:** All students will be expected to present the term paper prepared in group to familrize for presentation, questions, reactions, discussion and others in the class
4. **Laboratory reports / field reports**
5. **Examination**

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 15%

Presentation ---------- 5%

Lab/field reports ----------15%

Mid Exam ----------20%

Final Examination: Time and Date Set by the Office of the Registrar 45%

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	**Integrated Pest Management/Pest Management**
Credit hours	3 (2+3)
Course code:	PlPr 532

Objectives:

- To introduce the principles and applications of Integrated Pest Management;
- To introduce the challenges opportunities of Integrated Pest Management.
- To select the proper combinations of control methods in Integrated Pest Management

Course contents:

1. Introduction

1.1. Definitions

1.2. The pest problem

1.3. Concepts of IPM and its relevance

2. IPM and plant Protection

2.1. Basic principles of IPM

2.2. Methods of sampling

2.3. Estimation of disease intensity and yield loss

3. Pest development

3.1. Monitoring and forecasting pest outbreak

3.2. Pest control methods

3.2.1. Cultural

3.2.2. Physical

3.2.3. Biological

3.2.4. Host resistance

3.2.5. Chemical

3.2.6. Regulatory methods

4. Integration of different methods of pest control
5. Pest management options (methods and implementation)
6. Development of IPM for economically important field and horticultural crops
7. Adoption of IPM and factors hindering it
8. IPM in Ethiopia
9. Genetic engineering, modeling and system analysis
10. Methods of design,
11. Execution and analysis of experiments in different components of pest management,
12. Socio-economic aspects of integrated pest management.

Course delivery

The course will consist of lectures, classroom discussion, and review of scientific papers. Students will be given term papers on IPM related topics, which they will review and discuss them in class. Visit to different farmers' fields, sampling pest affected plants, determination of the pest status, investigation of the farming system with reference to pest intensity.

Assessment: Performance of students on the course will be assessed through research articles reviewing and presentation and discussion individually or in groups; reports on laboratory exercises and final written examination

SUMMARY OF COURSE ASSIGNMENTS

9. Home take assignments	10%
10. Mid Exam	20%
11. Lab move exam	20%
12. Final Exam	50%
Total	100%

References

1. Agrios, G.N. 2005. Plant Pathology (5th eds) New York: Academic Press.
2. Tweedy H. B. G, 1994. Pesticide Residues and Food safe
3. Mandal, R. C. 2007. Weed, Weedicide and Weed control Principles and practices.
4. Opender, K.et al., 2004, Integrated Pest Management, Potential, Constraints and challenges
5. Nair, K.R. 2007. Integrated Production and Pest Management
6. Srivastava K.P. and Ahlawat,, Y.S. 1999. Pest Management in Citrus
7. Srivastava K.P. and Dnamo K. Butani, 1998. Pest Management in Vegetables

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	
Course title	Agricultural Mycology
Credit hours	2 (1+3)
Course code:	PlPr 542

1. Course objectives:

- To become familiar with current taxonomy of plant pathogenic fungi and their important diseases.
- To become familiar with techniques for manipulating fungi such as isolation, identification and inoculation of pathogens.
- To gain the knowledge of different pathogenic mechanisms used by different groups of major fungal pathogens.
- To understand the ecology of various plant pathogenic fungi and fungal disease management strategies.
- To understand the plant fungal classification
- To develop the academic ability to critically review research articles about fungal diseases and their management.

2. Contents:

1. Characteristics:
    - ✓ Morphology
    - ✓ Reproduction
    - ✓ Ecology
    - ✓ Dissemination
2. Classification and Identification:
    - ✓ Fungal like organisms
    - ✓ The true fungi
    - ✓ Symptoms, Isolation
    - ✓ life cycles of fungi
    - ✓ Control of fungal diseases of plants
3. Diseases caused by fungal like organisms, Oomycetes and the Downy mildews:

- ✓ By Myxomycota (Myxomycetes)
- ✓ Plasmodiophoromycetes
- ✓ Clubroot of Crucifers
- ✓ Pythium damping-off
- ✓ Phytophthora diseases
- ✓ Root and stem rots, war on plants
- ✓ Late blight of potatoes

  Downy mildew of grape

4. Diseases Caused by true fungi:
   - Diseases caused by ascomycetes and mitosporic fungi
     - ✓ Sooty molds
     - ✓ Powdery mildews
   - Foliar diseases caused by ascomycetes and deuteromycetes (mitosporic fungi):
     - ✓ Alternaria diseases
     - ✓ Cladosporium diseases
     - ✓ Needle casts and blights of conifers
     - ✓ Mycosphaerella diseases
     - ✓ Banana leaf spot or sigatoka disease
     - ✓ Septoria diseases
     - ✓ Cercospora diseases
     - ✓ Rice blast disease
     - ✓ Cochliobolus
     - ✓ Phrenophora and
     - ✓ Setosphaeria diseases of cereals
   - tem and twig cankers caused by ascomycetes and deuteromycetes
     - ✓ Black knot of plum and cherry
     - ✓ Chestnut blight, nectria canker
     - ✓ Leucostoma canker
   - Anthracnose diseases caused by ascomycetes and deureromycetes
     - ✓ Elsinoe anthracnose and scab diseases
     - ✓ grape anthracnose or bird's-eye rot
     - ✓ Raspberry anthracnose
     - ✓ Citrus scab diseases
     - ✓ Avocado scab
   - Colletotrichum diseases of annual plants
     - ✓ Anthracnose of beans
     - ✓ Anthracnose of cucurbits
     - ✓ Anthracnose of ripe rot of tomato
     - ✓ Onion anthracnose or smudge

- ✓ Anthracnose of cereals and grasses

- Colletotrichum fruit rots:
  - ✓ Mango anthracnose ,
  - ✓ Citrus postbloom fruit drop,
  - ✓ Ripe rot of grape,

5. Fruit and general diseases caused by ascomycetes and deuteromycetes
   - ✓ Ergot of cereals
   - ✓ Botrytis diseases
   - ✓ Black rot of grape
   - ✓ Cucurbit gummy stem blight and black rot
6. Vascular wilts caused by ascomycetes and deuteromycetes
   - ✓ Fusarium wilts of tomato
   - ✓ Fusarium or panama wilt of banana
   - ✓ Verticillium wilts
   - ✓ Ophiostoma wilt of elm trees: dutch elm disease
   - ✓ Ceratocystis wilts
   - ✓ Oak wilt
   - ✓ Ceratocystis wilt of eucalyptus
7. Root and stem rots caused by ascomycetes and deuteromycetes
   - ✓ Gibberella stalk, ear, and seedling rot of corn
   - ✓ Fusarium (gibberella) head blight (fhb) or scab of small Grains
   - ✓ Fusarium root and stem rots of non-grain crops
   - ✓ Take-all of wheat
   - ✓ Thielaviopsis black root rot
   - ✓ Monosporascus root rot and vine decline of melons
   - ✓ Vegetables and flowers
   - ✓ Phymatotrichum root rot
8. Postharvest diseases of plant products caused by ascomycetes and deuteromycetes
   - ✓ Postharvest decays of fruits and vegetables
   - ✓ Control of postharvest
   - ✓ Decays of fresh fruits and vegetables
   - ✓ Postharvest decays of grain and legume seeds
   - ✓ Mycotoxins and mycotoxicoses:
     - ➢ Aspergillus toxins
     - ➢ Aflatoxins
     - ➢ Fusarium toxins
   - ✓ Other control of postharvest
   - ✓ Grain decays
9. Diseases caused by basidiomycetes

- ✓ The rusts
  - ➢ Cereal rusts
  - ➢ Stem rust of wheat and other cereals
  - ➢ Rusts of legumes, bean rust
  - ➢ Cedar-apple rust
  - ➢ Coffee rust
  - ➢ Rusts of forest trees
  - ➢ White pine blister rust
  - ➢ Fusiform rust
- ✓ The smuts
  - ➢ corn smut
  - ➢ loose smut of cereals
  - ➢ covered smut, or bunt, of wheat
  - ➢ Karnal bunt of small grains
  - ➢ legitimate concerns and political predicaments

10. Root and stem rot diseases caused by the"sterile fungi":
    - ✓ Rhizoctonia diseases
    - ✓ sclerotium diseases

3. Practical

Collection, isolation and preservation techniques of fungi; major characteristics of fungi for identification: colony/cultural, mycelial/hyphal characters, fructifications & types of fruiting bodies, sporulation & spore types, measuring spore dimensions; major groups of phytopathogenic fungi: representatives in the lower fungi including *Myxomycota*, *Mastigomycota*, *Zygomycota*; the higher fungi: *Ascomycota* (Ascomycetes), *Deuteromycota* (Imperfect fungi), and *Basidiomycota* (Basidiomycetes) with emphasis to the identification of genera and fungal species; phytopathogenic fungal microorganisms on economic crops in Ethiopia; field visits to experimental plots and production fields.

4. Evaluation:

The evaluation will be carried based on relevant tests, assignments, seminar and laboratory works and final examination

SUMMARY OF COURSE ASSIGNMENTS

13. Home take assignments	10%

14. Mid Exam	20%
15. Lab move exam	20%
16. Final Exam	50%
Total	100%

Grading: As per the university's regulation

5. Reference

1. Punja, Z. K. 2004. Fungal Disease Resistance in Plants: Biochemistry, Molecular Biology, and Genetic Engineering. Oxford Food Products Press, New York, USA. 289 pp.
2. Agrios, G.N. 2005. Plant Pathology (5th eds) New York: Academic Press.
3. Deacon, J. 2006. **Fungal Biology,** 4th edition. Blackwell Publishing Ltd, Main Street, Malden, USA. 380pp.
4. Webster, J and Weber, R. 2007.Introduction to Fungi, 3rd Edition. Cambridge, New York, USA. 875pp.
5. Strange, R.N. 2003. Introduction to Plant Pathology. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, England. 497pp.
6. Singh ,R.S.. 2005. Introduction to principles of Plant Pathology.
7. Pathak ,V.N., N., K. Kharti, M. Pathak. 2007. Fundamentals of Plant Pathology.

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	
Course title	Plant Disease Diagnosis and Development
Credit hours	2 (1+3)
Course code:	PlPr 572

1. Course objectives:

- To become familiar with detection and diagnosis techniques in advance with the exercise to be performed in the laboratory and in field conditions
- To become familiar with techniques for manipulating such as isolation, identification and inoculation of fungal and bacterial pathogens.
- To gain the knowledge of different pathogenic mechanisms used by different groups of major fungal pathogens.
- To become familiar with techniques of isolating phytopathogenic bacteria and fungi from plant tissue and from soil, including: Preparation, composition, and principles governing the choice of culture media, Isolation of fungi from plant tissue, by tissue plating, Isolation of bacteria from plant tissue by streaking and Isolation of fungi from soil by baiting.
- To develop the academic ability to critically review research articles about fungal diseases and their management.
- Review parts of a compound and a dissecting microscope and their functions, How to take care of a microscope, Practice effective use of a microscope, Learn about "Koehler" alignment of research microscopes, Review special types of light microscopy and Learn techniques of laboratory drawing.

2. Contents

1. GENERAL INTRODUCTION
   - 1.1. Introduction to the Course
   - 1.2. Laboratory Rules
     - 1.2.1. General rules:
     - 1.2.2. Specific rules
2. PRACTICAL EXERCISES
   - 2.1. Light Microscopy
   - 2.2. Principles and Structures of the Light Microscope
     - 2.2.1. The Compound Microscope: Its Parts and Their Use
     - 2.2.2. Dissecting Microscope
       1. Cleaning and Care
       2. Alignment of Research Microscopes
3. ISOLATION OF PLANT PATHOGENS (FUNGI AND BACTERIA)
   - 3.1. General Information
     - 3.1.1. Culture Media: Characteristics and Uses
     - 3.1.2. Essentials of Aseptic Technique
   - 3.2. Procedures
     - 3.2.1. Preparation of Potato Dextrose Agar
     - 3.2.2. Isolation of Fungal Pathogens from Plant Tissue
     - 3.2.3. Isolation of Bacteria from Plant Tissue by Streaking

3.2.4. Isolation of Fungi from Soil by Baiting

4. PURE CULTURE AND SINGLE-SPORE CULTURE METHODS
   - 4.1. Pure Culture Methods
     - 4.1.1. Transfer to Pure Culture
     - 4.1.2. Transferring to a Slant
   - 4.2. Culturing Single Spore Isolates

5. PREPARATION OF SPECIMENS FOR MICROSCOPIC EXAMINATION
   - 5.1. Temporary Wet Mount or Scrape Mount Technique
     - 5.1.1. Mounting Media
     - 5.1.2. Mounting Procedure
   - 5.2. Slide Culture Technique for Studying Morphology of Fungi
     - 5.2.1. Culture Procedure
     - 5.2.2. Preparation of Slide Mounts
   - 5.3. Cellophane Tape Preparation for Studying Morphology of Fungi
     - 5.3.1. Procedure
   - 5.4. Methods to Examine Pathogen Structures within Plant Tissues
     - 5.4.1. Clearing
     - 5.4.2. Free-Hand Sectioning
   - 5.5. Staining
   - 5.6. Preparation of Semi-Permanent/Permanent Microscope Slides
     - 5.6.1. Slide Culture Method
     - 5.6.2. Cover Slip Culture Technique for Permanent Fungus Mounts
     - 5.6.3. Microtome Sectioning to Prepare Permanent Slides
   - 5.7. Additional References

6. SIZE MEASUREMENT METHODS
   - 6.1. Micrometry
     - 6.1.1. Calibrating an Ocular Micrometer
     - 6.1.2. Measuring Spore Size
   - 6.2. Linear Determination of Colony Size

7. LONG TERM STORAGE OF PATHOGENS AND INFECTED PLANT TISSUE
   - 7.1. Preservation of Pure Cultures of Pathogens
   - 7.2. Preserving Specimens of Infected Plant Material
     - 7.2.1. Dry Specimens
     - 7.2.2. Storage in Liquid Preparations (Wet Specimens)
   - 7.3. Semi-Permanent and Permanent Slides

8. ARTIFICIAL INOCULATION AND DISEASE ESTABLISHMENT METHODS
   - 8.1. General Considerations in Artificial Inoculation
     - 8.1.1. Inoculum

8.1.2. Inoculation Method
8.1.3. Host and Environmental Factors
8.2. Principles and Procedures of Inoculum Standardization
8.2.1. Use of the Counting Chamber (Hemocytometer
8.2.2. Use of Plate Count Methods
8.3. Artificial Inoculation Methods: Principles and Procedures
8.3.1. Soil Infestation Methods
8.3.2. Inoculation of Plants or Plant-Parts
9. RECOGNITION AND TERMINOLOGY OF DISEASE SYMPTOMS & SIGNS
9.1. Identification Keys
9.1.1. Review of identification keys
9.1.2. Constructing Your Own Key
9.2. Symptomatology
9.2.1. The use of symptoms and signs in the diagnosis of plant diseases
9.2.2. Procedures
9.3. Symptoms and Signs – Keys and Glossaries
9.3.1. Macroscopic Symptoms (Key 1)
9.3.2. Key to Macroscopic Signs of Causal Agents (Key 2)
9.3.3. Key to Microscopic Signs and Symptoms (Key 3)
9.4. Glossary of Symptoms
9.5. Glossary of Signs
10. PLANT DISEASE DIAGNOSIS IN PRACTICE
10.1. Abiotic Diseases
10.2. Steps in Disease Diagnosis
10.3. Exercise in Disease Diagnosis
10.4. General and Specific References on Plant Disease Diagnosis
10.5. Appendix to the Chapter (diagnostic form)
11. PLANT DISEASE ASSESSMENT
11.1. Introduction
11.1.1. What do we actually measure? (The Parameters)
11.1.2. Why do we measure disease and loss?
11.2. Survey Methodology
11.2.1. Definition of Objectives
11.2.2. The Sample
11.2.3. Useful Background Information
11.3. Sampling Methods
11.4. Time and Frequency of Sampling
11.4.1. Factors to Consider
11.4.2. Plant Growth Stage Scales

11.5. Methods of Disease Assessment
  11.5.1. Direct Quantitative Methods
  11.5.2. Direct Qualitative Methods (Assessing the Infection Type)
  11.5.3. Indirect Methods of Disease Assessment
11.6. Crop Loss Appraisal
  11.6.1. Statistical Methods
  11.6.2. Experimental Methods

3. Evaluation:

The evaluation will be carried based on relevant tests, assignments, seminar and laboratory works and final examination and the SUMMARY OF COURSE Assessment is as follow

17. Home take assignments	20%
18. Laboratory exercise	20%
19. Laboratory move exams and reports	20%
20. Final Exam	40%
Total	100%

Grading: As per the university's regulation

4. Reference

Agrios, G. N. 1988. *Plant Pathology* (third ed.). Academic Press

Chiarappa, L., ed. (1971) *Crop Loss Assessment Methods*. Commonwealth Agricultural Bureaux.

Delp, B.R. Stowell, L.J. and Marois, J.J. (1986). Field runner: a disease incidence, severity and spatial pattern assessment system. *Plant Dis.* 70: 954-957.

Dhingra, O.D. and Sinclair, J.B. 1995. *Basic Plant Pathological Methods*, 2nd ed. Lewis Publ., pp. 123 – 135.

Jones, D.G., ed. (1998) *The Epidemiology of Plant Diseases*. Kluwer Academic Publ., pp. 42-72

Roberts, D. A., and Boothroyd, C. W. 1984. *Fundamentals of Plant Pathology* (second ed.). W. H. Freeman and Co., New York, NY. 432 pp. (especially pages 388-399)

Rossman, A. Y., Palm, M.E., and Spielman, L.J. 1994. *A Literature Guide for the Identification of Plant Pathogenic Fungi.* Amer. Phytopathol. Soc., St. Paul. 252 pp.

Shepppard, J. (2003) *Seed Testing International* 125: 20-21.

Streets, R. B. 1969. *The Diagnosis of Plant Disease*. University of Arizona Press, Tucson, AZ. 227 pp.

Program	Plant Science

Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	Agricultural Nematology
Credit hours	1(1+3)
Course code:	PlPr 512

Course Description: Nematology means the study of nematodes which are round worms in animal kingdom in phylum Nematoda and also are important agricultural pest. The course will introduce the student about agricultural nematodes including, history of Nematology, economic importance of plant parasitic nematodes; characters of the phylum Nematoda, their taxonomic position and relationships to other organism's dominance as a group, distribution etc., general morphology and biology of plant nematodes; important species infesting crops, the disease they caused and their control. This will also equip the students with knowledge of nematode, its effect on agriculture and management practices

Course objective: The course will enable students to recognize nematodes and the economic importance of plant parasitic nematodes, their taxonomic classification, distribution, general morphology, anatomy and biology of plant nematodes. Students will have knowledge to carry out diagnosis of plant parasitic nematode by collection, identification and mounting for references and also able to identify nematode problems and injury symptoms in different crops practically in the laboratory including field visits; to be able to monitor parasitic and pathogenic nematodes and application of management strategies.

TENTATIVE SCHEDULE OF LECTURE TOPICS AND READING

Week	Conceptual Focus	References
1	**CHAPTER 1: Introduction** 1. Introduction	•Agrios, G.N. 2005 (Fifth edition). •Mangala and

		Mauria 2012
2	**CHAPTER 2: History of Nematology** 1. History of Nematology	•Mentioned above
3	CHAPTER3:- ECONOMIC IMPORTANCE OF PLANT PARASITIC NEMATODE Economic importance of plant parasitic nematode	•Mentioned above
4	CHAPTER 4: CHARACTERSTICS OF PLANT PATHOGENIC NEMATODE 4.1. Morphology 4.2. Anatomy	•Mentioned above
5	4.3. Life cycle ……. 4.3.Life cycle	•Mentioned above
6	4.4. Ecology and spread… 4.4. Ecology and spread	•Mentioned above
7	CHAPTER 5: CLASSIFICATION OF NEMATODES 5.1. Cclassifications of nematodes	•Mentioned above
8	Classifications of nematodes….. Classificatiosn of nematodes	•Mentioned above
9	CHAPTER 6: ISOLATION OF	•Mentioned above

	NEMATODE 6.1. Isolation of nematodes from the soil	
10	6.2. Isolation of nematodes from Plant material Isolation of nematodes from Plant material	•Mentioned above
11	CHAPTER 7: SYMPTOMS CAUSED BY NEMATODES Symptoms caused by nematodes	•Mentioned above
12	CHAPTER 8: HOW NEMATODES AFFECT PLANTS How nematodes affect plants	•Mentioned above
13	CHAPTER 9: Interrelationship between nematodes and other plant pathogens 1. Interrelationship between Nematodes and other plant pathogens	•Mentioned above
14	CHAPTER 10: CONTROL OF NEMATODES Control of major nematodes	•Mentioned above
15	CHAPTER 11: IMPORTANT NEMATODES AND	•Mentioned above

	DISEASES Important nematodes and diseases	
16	CHAPTER 11: IMPORTANT NEMATODES AND DISEASES Important nematodes and diseases	•Mentioned above

N.B. The content will be updated every year from different web sites

Practical in Agricultural Nematology

Description for Practical Sessions

Students will be guided to study types of agricultural parasitic nematodes, morphology, anatomy, taxonomy, physiology, ecology, importance, disease symptoms, damaged crops by nematode, collection and isolation from soil and plant material, methods of isolation, identification, damaged specimen and nematode, preserving, recognition of diseases and others in detail will be done practically under field and laboratory condition.

TENTATIVE SCHEDULE OF PRACTICAL SESSIONS

Week	Practical Work	Assignment
1	**1. Farmers field visit** • Recognition of disease symptoms on different crops • Collection of damaged crops •Knowledge on disease sign and symptoms	Report writing
2	**1. Farmers field visit** • Collection of damaged crops • Recognize root knot diseases.	Report writing
3	1. Collection of damage crops • Recognize leaf diseases caused by nematodes etc. 2. Collection of damage crops	Report writing

Week	Practical Work	Assignment
4	• Recognize stem damage/diseases by different nematode spp., etc.	Report writing
5	3. Collection of damage crops • Recognize flower gall diseases by nematodes, etc.	Report writing
6	4. Preparation of collected damage specimens for identification under laboratory condition, etc.	Report writing
7	5. Isolation of nematodes from soil sample	Report writing
8	6. Isolation of nematodes from plant material	
9	7. Diagnosis of nematodes diseases	Report writing
10	8. Diagnosis of nematodes diseases	Report writing
11	9. Identification of nematode diseases	Report writing
12	10. Identification of nematode diseases	
13	11. Visiting Research centers, PHC, etc.	Report writing
14	12. Visiting Research centers, PHC, etc.	Report writing

METHODS OF EVALUATION

1. Term paper: All students will be required to complete literature review based papers on selected topics related to the course.

2. Presentation: All students will be expected to present the term paper and prepared her/his self for comments, questions, reactions, discussion and others during presentation.

3. Laboratory reports/field reports

4. Examination

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 20%

Presentation ---------- 10%

Lab/field reports ---------- 20%

Final Examination: Time and Date Set by the Office of the Registrar ---- 50%

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	
Course title	Ecology of Insect
Credit hours	2(1+3)
Course code:	PlPr 561

Insect Ecology: History of ecology; basic concepts; natural balance, interaction between biotic potential and environmental resistance; factors affecting insect distribution in space and time; biotic and climatic control; effects of constant and variable temperature, humidity, rainfall, light, pressure, sound and air currents, food number of generations, diapauses, hibernation, forecasts of insect outbreaks, insect migration, social life in insects, population study and estimation of losses, inter- and intra-specific competition, concepts of population dynamics, distribution, sampling and concepts of forecasting; generally the course will equip the students with knowledge of insect physiology including the concept of insect ecology.

Course objectives: The course will help the student to know the importance and scope of insect physiology and ecology; various insect systems (digestive, circulatory, respiratory, excretory, nervous and reproductive systems); physiology of digestion, absorption and metabolism of carbohydrates, lipids and nitrogenous compounds that is generally physiology of insect and also enables them to know history of insect ecology; basic concepts; difference between habitats; food

chain and succession; limiting factors and concepts of indicators; natural balance, interaction between biotic potential and environmental resistance; factors affecting insect distribution in space and time; biotic and climatic control; the students will demonstrate and do practical activities of insect physiology and ecology under laboratory and field conditions based on the laboratory manuals.

Course outline

CHAPTER-11	History of ecology
CHAPTER-2	Basic concepts of ecology
CHAPTER-3	Basic concepts and their difference between habitats
CHAPTER-4	Natural balance, interaction between biotic potential and environmental resistance
CHAPTER-5	Factors affecting insect distribution in space and time
CHAPTER-6	Biotic and climatic insect control
CHAPTER-6	Effects of constant and variable humidity, temperature, humidity, rainfall, sunlight, sound and air currents on insect survival
CHAPTER-7	Number of generations, hibernation, diapause and forecasts of insect outbreaks
CHAPTER-8	Insect migration and their social life
CHAPTER-9	Insect population study
CHAPTER-10	Estimation of losses due to insect pests
CHAPTER-11	Inter and intraspecific competition in insects
CHAPTER-12	Concepts of population dynamics, distribution, sampling and forecasting

CHAPTER-13	Concepts of population dynamics, distribution, sampling and forecasting

METHODS OF EVALUATION

1. Term paper: All students will be required to complete literature review based papers on selected topics related to the course.

2. Presentation: All students will be expected to present the term paper and prepared her/his self for comments, questions, reactions, discussion and others during presentation.

3. Laboratory reports/field reports

4. Examination

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 20%

Presentation ---------- 10%

Lab/field reports ---------- 20%

Final Examination: Time and Date Set by the Office of the Registrar ---- 50%

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	
Course title	Insect Physiology
Credit hours	3 (2+3)
Course code:	PlPr 522

Course Description: Insect physiology means the study of functions of insect body part and systems while the Insect Ecology means the study of biotic (bio-agents) and abiotic factors like temperature, humidity, rainfall, sunlight, pressure, sound and air currents in relation to insect life. The whole course will introduce students with detail knowledge on insect physiology and ecology.

Insect Physiology: Importance and scope of insect physiology; various insect systems (digestive, circulatory, respiratory, excretory, nervous and reproductive); physiology of digestion, absorption and metabolism of carbohydrates, lipids and nitrogenous compounds; physiology of insect systems including integument, endocrine glands, neurosecretions and their role in reproduction; hormones in insects and metamorphosis; nerve impulse transmission; physiology of sensory organs and their mode of functioning; growth, reproduction; importance of insect nutrition; nutrition of phytophagous insects; role of vitamins, proteins, amino acids, carbohydrates, lipids and minerals and other food constituents in insect nutrition.

Course objectives: The course will help the student to know the importance and scope of insect physiology and ecology; various insect systems (digestive, circulatory, respiratory, excretory, nervous and reproductive systems); physiology of digestion, absorption and metabolism of carbohydrates, lipids and nitrogenous compounds that is generally physiology of insect

Course outline

CHAPTER-1	Importance and scope of Insect physiology
CHAPTER-2	Insects Systems (digestive and circulatory)
CHAPTER-3	Insect systems (respiratory and excretory)
CHAPTER-4	Insect Systems (nervous and reproductive)
CHAPTER-5	Physiology of digestion and absorption
CHAPTER-6	Metabolism of carbohydrates, lipids and nitrogenous compounds
CHAPTER-7	Physiology of insect systems including integument, endocrine glands and neurosecretions
CHAPTER-8	Role of reproduction in insects and metamorphosis
CHAPTER-9	Role of hormones in insects and metamorphosis
CHAPTER-10	Nerve impulse transmission

CHAPTER-11	Physiology of sense organs and their mode of functioning
CHAPTER-12	Growth, reproduction and special modes of reproduction
CHAPTER-13	Importance of insect nutrition
CHAPTER-14	Nutrition of phytophagous insects
CHAPTER-15	Role of vitamins, proteins and amino acids
CHAPTER-16	Role of carbohydrates, lipids and minerals

METHODS OF EVALUATION

1. Term paper: All students will be required to complete literature review based papers on selected topics related to the course.

2. Presentation: All students will be expected to present the term paper and prepared her/his self for comments, questions, reactions, discussion and others during presentation.

3. Laboratory reports/field reports

4. Examination

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 20%

Presentation ---------- 10%

Lab/field reports ---------- 20%

Final Examination: Time and Date Set by the Office of the Registrar ---- 50%

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	Agricultural Pesticide and environment

Credit hours	2 (1+3)
Course code:	PlPr 562

Course Description: Pesticides are agricultural chemicals used to control harmful pests and also can play role in preventing, destroying, repelling or mitigating any pest. IPM refers to an ecological approach in pest management in which all available necessary techniques are consolidated in a unified program, so that pest populations can be managed in such a manner that economic damage is avoided and adverse side effects are minimized. Details of the course description are as follow.

(a) Pesticides - This course will provide students with knowledge of agricultural pesticides and their proper usage and concepts and scientific application of integrated pest management which include historical development of agricultural pesticides; nomenclature and chemistry of agricultural pesticides; classification and formulation of agricultural pesticides; chemical composition; mode of action; toxicological effects and general description of fungicides, insecticides, herbicides, acaroids, etc.

(b) Types of pesticides applications equipment and pesticide - Sprayers, dusters, fog generators, soil injection, seed treating drums, power operated sprayers and dusters, etc.; types of nozzles and their uses; **p**rinciples, factors affecting, advantages and disadvantages of various types of pesticides and its application; recent developments in agricultural pesticides such as insecticides, fungicides, herbicides, rodenticides, etc.; advances in formulation and residue analysis.

Course objective:- The course enables students to understand the type and chemistry of pesticides, know the classification of pesticides, understand the role of pesticides in agriculture, understand how to apply pesticides, understand the potential hazards of pesticides, understand safe use of herbicides and advice users to use them properly, advice pesticide users to use other options and consider pesticides as the last resort for the management of pest problem and also the course enables students to recognize common disease/pest problems of major crops; to carry out diagnosis of known and unknown diseases; to identify insect pest problems and injury symptoms in different crops; monitor crop pests / diseases, carry out crop loss assessment,

identify priorities for research; plan appropriate management strategies for particular crop pest/disease problems, learn and appreciate use of integrated tactics for pest control.

Course outline

CHAPTER 1: Agricultural pesticides and their proper usage and concepts

CHAPTER 2: Historical development of Agricultural pesticides

CHAPTER 3: Nomenclature and chemistry of agricultural pesticides

CHAPTER 4: Classification and formulation of Agricultural pesticides

CHAPTER 5: Uses, Mode of action of Agricultural Pesticides

CHAPTER 6: Toxicological and description of fungicides, insecticides, Herbicides etc.

CHAPTER 7: Sprayers, Dusters, Fog generators, Soil injection, Seed Treating Drums, Power operated sprayers and Dusters, etc.

CHAPTER 8: Types of nozzles and their Uses

CHAPTER 9: Principles, Factors affecting, advantages and disadvantages of various types of pesticides and its application

CHAPTER 10: Recent developments in agricultural pesticides (insecticides, fungicides, herbicides, etc.)

METHODS OF EVALUATION

1. Term paper: All students will be required to complete literature review based papers on selected topics related to the course.

2. Presentation: All students will be expected to present the term paper and prepared her/his self for comments, questions, reactions, discussion and others during presentation.

3. Laboratory reports/field reports

4. Examination

SUMMARY OF COURSE ASSIGNMENTS, TEST AND EXAM

Term Paper ---------- 20%

Presentation ---------- 10%

Lab/field reports ---------- 20%

Final Examination: Time and Date Set by the Office of the Registrar ---- 50%

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	Host pathogen Genetics and Breeding for Resistance
Credit hours	2(1+3)
Course code:	PlPr 552

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	Advanced Research Methods and Scientific Paper Writing
Credit hours	1(1+0)
Course code:	PlPr 521

Department	Plant Science
Degree program	MSc. in Plant Protection
Instructor	TBA
Course title	MSc Seminar in Plant Protection
Credit hours	1 (1+0)

Course code:	**PlPr 582**

Objectives:

- To introduce candidates to simple techniques of presentation and communication,
- To help them learn the methods of reviewing, analyzing, compiling and presenting most recent research works and findings, and

Description: A **MSc** candidate will select relevant scientific topic in consultation with the seminar advisor; sets the structural contents of the work; make exhaustive literature review on the selected seminar topic and analyze scientifically; summarize the review and present the relevant data in tables and figures; the candidate presents his/her observations and review facts (obviously related to his /her specialization) to the audience within the registered time frame or semester.

Delivery: MSc. seminar presentation will be announced to all interested participants and the candidate is expected to present his/her observations in the seminar on the selected topic related to his/her field of specialization. Presentation will be conducted using audio-visual aids like Power-point in a meeting hall for half an hour (10 to 15 minutes' presentation by the student and 10 to 15 minutes for discussion (questions and answers).

Assessment: Evaluation of the content and presentation by professionals and peers. School Graduate Council members will evaluate the course based on the organization of the compiled review paper; manner of presentation and response of the candidate to questions. An evaluation form prepared for this purpose will be used.

Staff Profiles

No	Name	Academic Rank	Educational Level	Specialization
1	Negash Hailu	Assistant Professor	Ph.D.	Plant Pathology
2	Estifanose Tsegaye	Assistant Professor	Ph.D.	Plant Pathology
3	Habtamu Kefelegn	Assistant Professor	M.Sc.	Crop Protection

4	Derib Alemu	Lecturer	M.Sc.	Plant Pathology
5	Etsegent H/Michale	Lecturer	M.Sc.	Agricultural Entomology
6	Amhayesus Belete	Lecturer	Ph.D. candidate	Agricultural Entomology
7	Beiment Abegaz	Lecturer	Ph.D. Candidate	Plant Pathology
8	Bizuayehu Desta	Assistant Professor	Ph.D.	Horticulture
9	Wondosen Tena	Assistant Professor	Ph.D.	Soil Science
10	Azemeraw Ayew	Assistant Professor	Ph.D.	Development studies
11	Asmare Melese	Associate Professor	Ph.D.	Soil Science
12	Girma Tadesse	Assistant Professor	Ph.D.	Soil Science