



ANNAMALAI UNIVERSITY

(Accredited with 'A' Grade by NAAC)



FACULTY OF AGRICULTURE

(Accredited by ICAR)

DEPARTMENT OF PLANT PATHOLOGY

Academic Regulations and Syllabi

MASTER OF SCIENCE IN PLANT PATHOLOGY

**Under Choice based credit system (CBCS) with
Outcome based Education**

2022-2023 Onwards

FACULTY OF AGRICULTURE

Common Regulations for All M.Sc. (Agriculture/Horticulture) and M.B.A. (Agri-Business Management) programmes offered by the Faculty of Agriculture (With effect from 2022-2023)

1. Short title and commencement

- 1.1 These rules and regulations shall govern the post graduate studies leading to the award of degree of Master of Science (Agriculture/Horticulture) and M.B.A. (Agri. Business Management) in the Faculty of Agriculture.
- 1.2 They shall come into force with effect from the academic year 2022 – 2023.

2. Academic Year and Registration

- 2.1 An academic year shall be normally from July to June of the following calendar year otherwise required under special situations. It shall be divided into two academic terms known as semesters. The Academic Calendar will be developed by the University from time to time and notified accordingly by the Registrar in advance.
- 2.2 An orientation programme shall be organized by the Dean, Faculty of Agriculture for the benefit of the newly admitted students immediately after commencement of the semester.
- 2.3 On successful completion of a semester, the continuing students shall register for subsequent semester on the date specified in the Academic/ Semester Calendar or specifically notified separately. Every enrolled student shall be required to register at the beginning of each semester till the completion of his/ her degree programmes

3. Registration Card

- 3.1 A student shall register the courses offered in a semester by writing all the courses in registration card in quadruplicate.
- 3.2 The Chairman, PG coordinator and Head of the Department are responsible to furnish the registration particulars of the students with their signature in the registration card to the Dean.
- 3.3 The Dean shall approve the registration card.
- 3.4 The approved registration card shall be maintained by the Head of the Department, Chairman and the student concerned.
- 3.5 The list of courses registered by the students in each semester shall be sent by the Head of the Department to the Controller of Examinations/University for preparation of Report Cards

4. Definitions

- 4.1 **Semester** means an academic term consisting of 110 working days including final theory examinations.
- 4.2 **Subject** means a unit of instruction to be covered in a semester having specific No., title and credits.
- 4.3 **Credit hour** means, one hour lecture plus two hours of library or homework or two and half hours of laboratory/field practical per week in a semester.
- 4.4 **Grade Point of a subject** means the value obtained by dividing the percentage of marks earned in a subject by 10 and the Grade Point is expressed on a 10 point scale.
- 4.5 **Credit Point** means the grade point multiplied by credit hours.
- 4.6 **Grade Point Average (GPA)** means the quotient of the total credit points obtained by a student in various subjects at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 point scale and the GPA has to be corrected to two decimals.
- 4.7 **Overall Grade Point Average (OGPA)** means the quotient of cumulative credit points obtained by a student in all the subjects taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

5. Programmes offered

The details of various post-graduate degree programmes at Masters' level offered in the Faculty of Agriculture are as follows:

1. M.Sc. (Ag.) Agronomy
2. M.Sc. (Ag.) Entomology
3. M.Sc. (Ag.) Agricultural Microbiology
4. M.Sc. (Ag.) Genetics and Plant Breeding
5. M.Sc. (Ag.) Seed Science and Technology
6. M.Sc. (Ag.) Molecular biology and Biotechnology
7. M.Sc. (Ag.) Plant Pathology
8. M.Sc. (Ag.) Soil Science
9. M.Sc. (Ag.) Agricultural Extension Education
10. M.Sc. (Ag.) Agricultural Economics
11. M.B.A. (Agri-Business Management)
12. M.Sc. (Hort.) Fruit Science
13. M.Sc. (Hort.) Vegetable Science
14. M.Sc. (Hort.) Floriculture and Landscaping
15. M.Sc. (Hort.) Plantation, Spices, Medicinal and Aromatic Crops

6. Eligibility for admission

Candidates for admission to the M.Sc.(Ag./Hort.) and M.B.A.(Agri- Business Management) programme should satisfy the following requirements.

6.1. Candidates seeking admission to the M.Sc. (Ag./Hort.) and M.B.A.(Agri-Business Management) Degree programme should have completed any one of the following four year degree programmes from Faculty of Agriculture, Annamalai University or Universities/colleges accredited with ICAR, New Delhi.

Program of study	Eligibility
M.Sc. (Ag.) Agronomy	B.Sc. (Hons) Agriculture/ B.Sc. (Ag.) courses of four years duration.
M.Sc. (Ag.) Entomology, M.Sc. (Ag.) Genetics and M.Sc. (Ag.) Plant Breeding, M.Sc. (Ag.) Plant Pathology, M.Sc. (Ag.) Soil Science, M.Sc. (Ag.) Seed Science and Technology, M.Sc. (Ag.) Molecular biology and Biotechnology, M.Sc. (Ag.) Agricultural Microbiology, M.Sc. (Ag.) Agricultural Extension Education, M.Sc. (Ag.) Agricultural Economics and M.B.A. (Agri. Business Management)	B.Sc. (Hons) Agriculture / B.Sc. (Hons) Horticulture/ B.Sc. (Ag.) / B.Sc. (Hort.) of four years duration.
M.Sc. (Hort.) Fruit Science M.Sc. (Hort.) Vegetable Science M.Sc. (Hort.) Floriculture and Landscaping M.Sc. (Hort.) Plantation, Spices, Medicinal and Aromatic Crops	B.Sc. (Hons) Agriculture / B.Sc. (Hons) Horticulture/ B.Sc. (Hort.) and B.Sc. (Ag.) courses of four years duration.

6.2. Candidates who have undergone the programme under conventional system should possess not less than a second class Bachelor's degree. The candidates under 4 point grade systems should possess a minimum OGPA of 2.5 out of 4.00 and 2.75 out of 4.00 in the subject concerned. For those under 10 point system a minimum OGPA of 6.50 out of 10.00 and 7.00 out of 10.00 in the subject concerned is required. However, for SC/ST candidates OGPA of 6.75 out of 10.00 in the subject concerned is sufficient.

6.3. An entrance test will be held separately for each Degree programme. Selection of candidates shall be based on OGPA, Subject OGPA, Entrance Test and Interview.

6.4. A student can apply to a maximum of two subjects only.

7. Programme Requirements

7.1. Residential requirements

The duration for the M.Sc. (Agriculture/Horticulture) and MBA programme will be of two years with four semesters. A student registered for M.Sc.

(Agriculture/Horticulture) programme should complete the course within five academic years from the date of his/her admission. In case a student fails to complete the degree programme within the maximum duration of residential requirement, his/her admission shall stand cancelled.

7.2. Credit Grade Point Requirements

A student enrolled for the Master's degree programme to earn eligibility for the degree is required to complete 70 credits as detailed below.

Course work	Credit
Major Courses	20
Minor Courses	08
Supporting Courses	06
Common Courses	05
Seminar	01
Thesis Research	30
Total credits	70

7.3 Major course: From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken will be given *mark

7.4 Minor course: From the courses closely related to a student's major subject, minor courses shall be chosen by the students in consultation with the Head of the department and the Chairman based on their research specialization.

7.5 Supporting courses: The subjects not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

a. List of supporting courses for M.Sc. (Ag.) Agronomy, Entomology, Genetics and Plant Breeding, Plant Pathology, Soil Science, Seed Science and Technology, Molecular biology and Biotechnology, Agricultural Microbiology and Horticulture are

STA 501 Statistical Methods for Applied Sciences 3(2+1)

COM 501 Information Technology in Agriculture 3(2+1)

b. List of supporting courses for Agricultural Economics and M.B.A (Agri-Business Management)

STA 502 Statistical Methods for social Sciences 3(2+1)

COM 501 Information Technology in Agriculture 3 (2+1)

c. List of supporting courses for M.Sc. (Ag.) Agricultural Extension education,

STA 502 Statistical Methods for social Sciences 3 (2+1)

COM 502 Computer application for Agricultural extension research 3 (2+1)

7.6 Common Courses: There will be five common courses (one credit each) will be offered to all students undergoing Master's degree programme. Among the five common courses, the following four courses will be offered in all the Master's degree programme:

1. PGS 501- Agricultural Research, Research Ethics and Rural Development Programmes (1+0)
2. PGS 502 - Technical Writing and Communications Skills (0+1)
3. PGS 504- Library and Information Services (0+1)
4. PGS 505- Intellectual Property and its management in Agriculture (1+0)

The fifth common course for Master's degree programme in Agronomy, Entomology, Genetics and Plant Breeding, Seed Science and Technology, Molecular biology and Biotechnology, Plant Pathology, Soil Science, Agricultural Microbiology, Fruit Science, Vegetable Science, Floriculture and Landscaping, and Plantation, Spices, Medicinal and Aromatic Crops will be

- PGS 503 - Basic Concepts in Laboratory Techniques (0+1)

The fifth common course for Master's degree programme in Agricultural Economics and M.B.A (Agri. Business Management) will be

- PGS 507 – Basic Analytical Techniques (0+1)

The fifth common course for Master's degree programme in M.Sc. (Ag.) Agricultural Extension will be

- PGS506– Basic Laboratory Techniques for Audio and Video Production (0+1)

Some of these courses are already in the form of e-courses/ MOOCs. The students may be allowed to register these courses/ similar courses on these aspects, if available online on SWAYAM or any other platform. If a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/ Board of Studies (BoS).

7.7 Minimum Grade point requirement

A post graduate student should maintain a minimum Grade Point of 6.50 out of 10 to secure a pass in a subject. In the subjects in which a student fails, he/she has to reappear for the examination to get a pass in that subject.

8. Attendance requirement

8.1. One hundred per cent attendance is expected of each student. A student, who fails to secure a minimum of **80 per cent** of attendance in each subject separately for theory and practical, shall not be permitted to appear for the final examination in that subject and will be required to repeat the subject when ever offered.

In case of new admission, who are permitted to join late due to administrative reasons, the attendance will be calculated from the date of joining of the student. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice-Chancellor on the recommendation of the Head of the

Department and the Dean, Faculty of Agriculture on payment of condonation fee prescribed by the University.

8.2. Students absenting from the classes with prior permission of the Head of the Department/Dean, Faculty of Agriculture on official University business shall be given due consideration in computing attendance.

9. Advisory Committee

9.1. Each post-graduate student shall have an Advisory Committee to guide him/her in carrying out the research programme. The Advisory Committee shall comprise a Major Adviser (Chairman) and two members. Of the two members, one will be from the same Department and the other in the related field from the other Departments of Faculty of Agriculture. The Advisory Committee shall be constituted within three weeks from the date of commencement of the first semester.

9.2. For interdisciplinary research requiring expertise from teaching staff of other faculties, due permission need to be obtained from the Dean, Faculty of Agriculture to nominate them as Technical advisors. An official letter in this regard needs to be communicated to the individual concerned through the respective Head of the Department and Dean. However, they are restrained from the evaluation of Research/Seminar.

9.3. Major Adviser (Chairman)

Every student shall have a Major Adviser who will be from his/her major field of studies. The appointment of Major Adviser (Chairman) shall be made by the Head of the Department concerned. The chairman in consultation with the Head of the Department will nominate the other two members. In the event of the Major Adviser being away on other duty/leave for a period of more than three months, the member of the Advisory Committee from the same Department will officiate as the Major Adviser.

9.4 Advisor/ Co-guide/ Member, Advisory Committee from other collaborating University/ Institute/ Organization

- In order to promote quality Post-graduate research and training in cutting edge areas, the University may permit the scholar to conduct research in other university/ research institute/ Organization. While constituting an Advisory Committee of a student, if the Chairperson, Advisory Committee feels the requirement of involving of a faculty member/ scientist of such partnering university/ Institute/ Organization, he/ she may send a proposal to this effect to the Dean, Faculty of Agriculture along with the proposal for consideration of Student's Advisory Committee.

- The proposed faculty member from the partnering institution can be allowed to act as Chairperson/ Co-guide/ Member, Advisory Committee, by mutual consent, primarily on the basis of intellectual input and time devoted for carrying out the research work at the particular institution.

9.5 Allotment of students to the retiring persons

Normally, retiring faculty may not be allotted with M. Sc. Student if he/ she is left with less than 2 years of service.

9.6 Changes in the Advisory Committee:

- i. Change of the Chairperson or any member of the Advisory Committee is not ordinarily permissible. However, in exceptional cases, the change may be effected with due approval of the Dean, Faculty of Agriculture.
- ii. Normally, staff members of the university on extra ordinary leave or on study leave or who leave the University service will cease to continue to serve as advisors of the Post-graduate students of the University. However, the Dean, faculty of Agriculture may permit them to continue to serve as advisor subject to the following conditions:
 - a) The concerned staff member must be resident in India and if he/ she agrees to guide research and must be available for occasional consultations;
 - b) An application is made by the student concerned duly supported by the Advisory Committee;
 - c) The Head of the Department and the Dean, Faculty of Agriculture agree to the proposal;
- iii. In case the Chairperson/ member of Advisory Committee retires, he/ she shall be allowed to continue provided that the student has completed his course work and minimum of 10 research credits and the retiring Chairperson/ member stays at the Headquarters of the College, till the thesis is submitted.
- iv. The change shall be communicated to all concerned by the Head of Department.

9.7 Guidelines on the duties of the Advisory Committee

- Guiding students in drawing the outline of research work
- Guidance throughout the programme of study of the students.
- Evaluation of research and seminar credits.
- Correction and finalization of thesis draft.
- Conduct of final Viva-Voce examination.
- The proceedings of the Advisory Committee will be sent to the Head of the Department concerned within 10 working days.
- Periodical review of the Advisory Committee proceedings will be made by the Head of the Department concerned.

10. Programme of Study

10.1. The student's plan for the post-graduate work, drawn up by the Advisory Committee, shall be finalized before the end of the first semester.

10.2. The programme shall be planned by the Advisory Committee taking into account his/her previous academic training and interest.

10.3. Programme of research work

The outline of research work of the student, in the prescribed manner and as approved by the Advisory Committee, shall be forwarded by the Chairman to the Head of the Department concerned by the end of the first semester.

11. Evaluation of Students' Performance

Multiple levels of evaluation (First Test, Midterm and Final semester) will be conducted.

11.1. First Test (FT)

Every teacher handling a subject shall conduct first Test (FT) as per the scheme drawn by the Head of the Department concerned /PG coordinator on the fourth week from the date of registration of the course, and evaluate. The evaluation process will be based on objective type questions and short concepts.

11.2. Mid-semester examination (MSE)

11.2.1. Every teacher handling a subject shall conduct Mid-Semester Examination (MSE) as per the scheme drawn by the Head of the Department concerned /PG coordinator, on the eighth week from the date of registration of the course and evaluate. The evaluation process will be of descriptive type.

11.2.2. The answer scripts of both FT and MSE will be shown to the student after valuation, and returned to the course teacher. The Head of the Department will be responsible to ensure the distribution of answer papers to the students. The marks obtained by the students should be sent to the Controller of Examinations through the Head of the Department concerned within fifteen working days.

11.2.3. Writing the first test and mid-semester examination is a pre-requisite for writing the final theory and practical examinations. If a student does not appear for FT/MSE, he/she is not eligible to appear for the final examinations. Such candidate has to reappear for the FT/MSE as and when the respective examinations are conducted only after getting permission from the Head of the Department concerned.

11.2.4. The FT and MSE marks will not be shown separately in the grade sheet but will be combined with the respective final theory and practical marks. FT and MSE marks awarded in a course will be added to the supplementary examinations also.

11.2.5. The FT and MSE marks will be furnished to the Head of the Department within 10 days after the conduct of Ft and MSE. If the student is not satisfied with the award of the marks, he/she shall appeal to the Dean, through Head of the Department within three working days after the announcement of marks. The appeal will be considered and the results reviewed by a Cell consisting of the Dean and the Head of the Department concerned. The decision of the Review Cell shall be final. If the Head of the Department himself is the course teacher, one senior member of the department concerned shall be nominated by the Dean.

11.2.6. The first test will be of 30 minutes duration and MSE of theory will be of one hour duration.

11.2.7. If the student is not able to write the FT/ MSE due to deputation by the University, he/she may be permitted to take up missing FT/MSE. Such examination should be completed ordinarily within 15 working days after the respective Ft/MSE.

11.2.8.A student who fails to attend a first test and mid-semester examination due to unavoidable circumstances shall be permitted with prior approval of the head of the Department to take up missing examination of the particular course. Such tests should be completed ordinarily within 15 working days after the respective FT/MSE.

The distribution of marks will be as indicated below.

Test	Subjects with Practical	Subjects without Practical	Subjects without Theory
First test	10	20	20
Mid-Semester	20	30	30
Final theory	30	50	-
Final practical	40	-	50
Total	100	100	100

The question paper model and distribution of marks for Mid Semester examinations is as follows.

First Test (30 minutes duration) (Total Marks: 10)

1. Objective Type	10 out of 12	10 x 0.5 marks	5 Marks
2. Definitions/ Short Concepts	5 out of 7	5 x 1 marks	5 Marks

Mid-semester examination

For Subjects with practical(One hour duration) (Total marks: 20)

1. Objective Type	10 out of 12	10 x 0.5 marks	5 Marks
2. Definitions/ Concepts	5 out of 7	5 x 1 marks	5 Marks
3. Short Notes	2 out of 3	2 x 2 ½ marks	5 Marks
4. Essay Type	1 out of 2	1 x 5 marks	5 Marks

For Subjects without practical (One hour duration) (Total marks: 30)

1. Objective Type	10 out of 12	10 x 0.5	5 Marks
2. Definitions/Concepts	5 out of 7	5 x 1	5 Marks
3. Short Notes	4 out of 5	4 x 2 ½	10 Marks
4. Essay Type	2 out of 3	2 x 5	10 Marks

11.3. Final examination

11.3.1. The final theory examination will be of two and a half hours duration and practical examination will be of three hours duration, both conducted separately by the University. The question paper for the theory examination will be set as per Bloom's taxonomy by the concerned course teacher in consultation with the Head of the Department. The final theory and practical examinations will be evaluated by respective course teacher.

11.3.2. The question paper model and distribution of marks for final theory examinations are as follows.

Final theory examination (3 hours duration)

For subjects with practical (Total marks: 30)

1. Definitions	5 out of 7	5 x 1 marks	5 marks
2. Short Notes	2 out of 3	2 x 2½ marks	5 marks
3. Essay Type	Either or type (one question from each unit)	5 x 4 marks	20 marks

For subjects without practical (Total marks: 50)

1. Definitions	6 out of 8	6 x 1 marks	6 marks
2. Short Notes	3 out of 5	3 x 3 marks	9 marks
3. Essay Type	Either or type (one question from each unit; At least two questions must represent K6 level of Bloom's taxonomy)	5 x 7 marks	35 marks

11.3.3. Practical Examination

Practical examinations will be conducted in the last practical class. Proper maintenance and regular submission of practical records are required. Those who do not bring with them the certified practical records/ specimen collection/ assignments will not be allowed to appear for the practical examination. The marks awarded for specimen collection and assignments shall be noted in the record, at the time of first appearance and will be taken into account for subsequent appearances.

If a student secures a 'pass' in the practical examination of a particular course and fails in the theory examination, then, the practical examination marks obtained in the first attempt will be added to the supplementary examinations also and he/she doesn't require to reappear for practical examination.

Assignment

Each student will be assigned a topic by the concerned course teacher. Such topic should cover a wide range of topics within the subject limits. The topic should be different from that of the credit seminar. Assignments will be evaluated during practical examination. The distribution of marks for **final practical examination** for courses with theory and practical and only practical is as follows:

S.No.	Particulars	Courses with theory and practical	Courses only with practical
1	Practical part	25	35
2	Assignment/specimen collection	5	5
3	Record	5	5
4	Viva voce	5	5
Total		40	50

The pattern of practical part should be uniform in each Department

11.4. GRADING

- The student should secure 60 per cent marks separately in theory and practical and 65 per cent marks in aggregate to secure a pass in the subject. Students who secure marks below 65 per cent in a subject will be treated as Reappearance (RA).
- Each subject shall carry a maximum of 100 marks for purpose of grading. The grading shall be done as grade point, i.e., the percentage of marks earned in a subject is divided by ten. The grade point is expressed on a 10 point scale up to two decimals.
- The reappearance examinations for the candidates who fail in a subject or subjects will be held in the subsequent semester.
- Students who did not fulfill the required minimum attendance of **80 per cent** will be awarded 'E' grade and has to repeat the subject.

11.5. Percentage equivalence and Class ranking

In calculation of percentage and class equivalent for OGPA the following formula shall be adopted.

$$\text{Percentage equivalent for OGPA} = \frac{\text{Sum of marks obtained by the candidates in all the courses}}{\text{Sum of maximum marks in all the Courses}} \times 100$$

In calculation of percentage and class equivalent for OGPA, the following classification shall be adopted.

OGPA	Percentage	Class
9.00 and above	90 and above	Distinction
8.00 to 8.99	80.00 to 89.99	I Class
7.00 to 7.99	70.00 to 79.99	II Class
6.50 to 6.99	65.00 to 69.99	Pass

12. Credit Seminar

Seminar is compulsory for all the students and each student should present a seminar of 0+1 credit in the third semester.

12.1. The seminar topic should be only from the major field and should not be related to the area of thesis research. The seminar topics are to be assigned to the students by the Chairman of the Advisory Committee in consultation with the Head of the Department concerned within 2 weeks after the commencement of the semester.

12.2. Under the guidance and supervision of the Chairman of the Advisory Committee, the student will prepare the seminar paper after reviewing all the available literature and present the seminar 2 weeks after completion of Mid-Semester Examination in the presence of the Head of the Department, Advisory Committee, staff members and PG students.

12.3. The circular on the seminars by the post-graduate students shall be sent to other Departments to enable those interested to attend the same.

12.4. The Chairman will monitor the progress of the preparation of the seminar paper and correct the manuscript containing not less than 25 typed/printed pages with a minimum number of 50 references covering the recent 10 years' time. The student will submit 2 copies of the corrected manuscript to the Head of the Department concerned through the Chairman before presentation.

The student will incorporate suggestions and carry out corrections made during the presentation and resubmit three fair copies to the Head of the Department concerned through the Chairman (one copy each to Dept. Library, Chairman and the student) within 10 days after presentation.

12.5. The performance of the student has to be evaluated for 100 marks and Grade Point will be awarded by Advisory Committee. The Grade Point may be given based on the following norms.

Coverage of Literature	40
Presentation	30
Use of Audio–Visual Aids	10
Capacity to Participate in the discussion and answer the Questions	20
Total	100

13. Absence of advisory committee member during final viva-voce examination:

13.1 Conducting final viva voce examination in the absence of advisory committee members is not allowed.

13.2. Under extra-ordinary circumstances if the final viva-voce examination to postgraduate student has to be conducted in the absence of one or two advisory committee members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Dean in advance through the Head of the Department. The Chairman of the advisory committee in consultation with the concerned member and Head of the Department will co-opt another member.

13.3. The co-opted member should be from the same department of the member who is not attending the examinations.

13.4. In the absence of the Chairman of advisory committee, respective Heads of Departments should act as Co-chairman with prior permission of Dean.

14. Research Work

14.1. The topic of thesis research to be carried out by the student will be assigned by the Chairman of the Advisory Committee in consultation with the Head of the Department concerned. After assigning the topic, each student may be instructed to submit a detailed programme of work to be carried out by him/her during the semester in the prescribed proforma. After scrutiny and approval, a copy of the programme may be given to the student for carrying out the work during the semester

in the prescribed proforma. The evaluation of research work done by the student should be based on the approved programme.

14.2. The distribution of research credits will be as follows:

I Semester	0+ 2
II Semester	0+ 6
III Semester	0+ 10
IV Semester	0+ 12*
Total	0 + 30

(* In the fourth semester, out of 12 credits, 8 credits will be for evaluation of research and remaining 4 credits for evaluation of viva voce)

15. Evaluation of Thesis Research

15.1. Attendance register must be maintained in the department by HOD /major adviser for all the students to monitor whether the student has 80% of attendance in research.

15.2. The student has to submit his/her research observation note book to the major Adviser. The major Adviser will scrutinize the progress and sign the note book with remarks as frequently as possible. This note book will form the basis for evaluation of research progress.

15.3. After completion of 80% attendance for research and on or before the last day of the semester, the advisory committee should evaluate the progress of research work as per the approved programme and monitoring register and award **SATISFACTORY OR UNSATISFACTORY** depending upon quantity and quality of work done by the student during the semester.

15.4. The procedure of evaluating research credits under different situations are explained hereunder.

Situation - I

The student has completed the research credits as per the approved program and awarded '**SATISFACTORY**' by the advisory committee. Under the said situation, the student can be permitted to register fresh credits in the subsequent semester. If the student is awarded '**UNSATISFACTORY**', he/she has to register afresh the same block of the research credits in the subsequent semester.

Situation - II

The student who does not satisfy the required **80 per cent** attendance shall be awarded grade '**E**'.

Situation-III

The student who could not complete the research work as per the approved programme of work for reasons beyond his/her control such as

- Failure of crop
- Non-Incidence of pests or diseases or lack of such experimental conditions
- Non-availability of treatment materials like planting materials chemicals etc.
- Any other impeding/ unfavourable situation for satisfying the advisory committee
- Under the situations II&III, grade 'E' should be awarded. The student has to re-register the same block of research credits for which 'E' grade was awarded in the following semester. The student should not be allowed to register for fresh (first time) research credits.
- In the mark sheet, it should be mentioned that 'E' grade was awarded due to lack of attendance or want for favourable conditions.

Situation – IV

The student who fails to complete the research work after repeating the registration for the second time will be awarded '**Unsatisfactory**'.

- For the registration of research credits for the third time, permission has to be obtained from the Dean of the Faculty and permission for further registration for the fourth time has to be obtained from the University.
- Re-registration of further research credits shall be decided by the University based on the recommendation of the Advisory Committee, Head of the Department concerned and the Dean, Faculty of Agriculture.

16. Submission of Thesis

16.1. The thesis for his/her Master's degree should be of such a nature as to indicate a student's potentialities for conduct of independent research. The thesis shall be on topic falling within the field of the major subject and shall be the result of the student's own work. A certificate to this effect duly endorsed by the Major Adviser (Chairman) shall accompany the thesis.

16.2. The research credits registered in the last semester of post graduate programmes should be evaluated only at the time of the submission of thesis, by the advisory committee. Students can submit the thesis at the end of the final semester. If a post graduate student has completed the thesis before the closure of the final semester, the chairman can convene the advisory committee meeting and take decision on the submission of thesis provided the student satisfies 80 per cent attendance requirement. Two copies of the thesis should be submitted in paper pack for evaluation to the HOD.

16.3. The thesis shall contain a certificate from the supervisor specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him/her, and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or similar title. A statement from the supervisor indicating the

extent to which the thesis represents independent work on the part of the candidate should also be made including free from plagiarism **above the specified level.**

16.4. The thesis shall also contain a declaration by the candidate that the work reported in the thesis has been carried out by the candidate himself/herself and that the material from other sources, if any, is duly acknowledged and no part of the thesis is plagiarized **more than 25 %.**

17. Grace period

17.1. Students can avail a grace period up to a month for submission of thesis/project report after the closure of final semester by paying necessary fine as prescribed by the University. If a student is not able to submit the thesis within a month (grace period), the student has to re-register the credits in the forthcoming semester. The student who re-register the credits after availing the grace period will not be permitted to avail grace period.

17.2. Based on the recommendation of advisory committee and the Head of the Department, the Dean, can sanction the grace period. A copy of the permission letter along with the receipt for payment of fine as prescribed by the University should accompany the thesis while submission.

18. Submission of thesis after re-registration

The minimum of 80 per cent attendance requirement for submitting the thesis after, re-registration need not be insisted for those students who have fulfilled the minimum academic and residential requirement i.e. 2 years (4 semesters) and completed the minimum credit requirements for getting Degree.

19. Publication of articles

Part of the thesis may also be published in advance with the permission of the HOD. If any part is published, the fact should be indicated in the certificate given by the chairman that the work has been published in part/full in the scientific or popular journals, proceedings, etc. The copies are to be enclosed in the thesis at the time of submission.

20. Evaluation of Thesis

20.1. The thesis submitted in partial fulfillment of a Master's degree shall be evaluated by an external examiner. The external examiner shall be a specialist in the student's major field of study from outside Annamalai University and shall be appointed by the University as per the recommendation of the Head of the Department.

20.2. The external examiner will send the evaluation report in duplicate, one marked to the Controller of Examinations and another to the Head of the Department along with the corrected copy of the thesis. If the report is favourable, Viva-Voce will be arranged

by the Head of the Department concerned and conducted by the Advisory Committee along with the external examiner. The chairman of the advisory committee shall send the recommendations of the examining committee to the Controller of Examinations through Head of the Department after the student duly carries out the corrections/suggestions mentioned by the external examiner (a certificate to be enclosed along with the recommendation). On the unanimous recommendation of the committee and with the approval of the University, the degree shall be awarded to the candidate.

20.3. In case of rejection of the thesis by the external examiner, the Head of the Department concerned and Advisory Committee shall refer the thesis for evaluation by a second external examiner. If the second external examiner recommends the thesis for acceptance, Viva-Voce will be conducted.

20.4. If the revision of the thesis is recommended for repeating experiments, field trial etc., resubmission must be done by the candidate concerned after a minimum of six months. The revised version should be sent to the examiner who recommended revision.

20.5. After incorporating the suggestions of the examiners and those received at the time of viva-voce, three hard bound copies of thesis should be submitted to the Department (one to the scholar, one to the chairperson and one to the Department Library) and one soft copy in CD to the Department. Along with two copies of the thesis, two copies of abstract of thesis (in 10-15 lines) and summary of the findings both in Tamil and English and soft copy both in a C.D. shall be submitted. At the time of final submission, the Chairman of the advisory committee should certify that the corrections and suggestions have been carried out as indicated by the examiners.

21. Revision of thesis

If an examiner recommends for revision of thesis, the following norms will be adopted.

21.1. For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from the Controller of Examinations

21.2. At the time of submission, the advisory committee should give certificate for carrying out the corrections/recommendations. The resubmitted copies of thesis should be got corrected after carrying out the necessary corrections indicated by the external examiner and necessary certificates shall be obtained from the chairman and HOD before the conduct of the final viva-voce.

21.3. A fine prescribed by the University to be collected from the students at the time of resubmission of thesis.

22. Failure to appear for final Viva-voce/ Non submission of thesis after viva-voce.

22.1. If a candidate fails to appear before the examining committee for final viva-voce, on the date fixed by the HOD, the following are the time frame and penalty.

22.2. The re-viva-voce must be completed within two years. An amount of fine prescribed by the University must be charged to the candidate.

22.3. After successful completion of thesis final viva-voce, if a student fails to submit the corrected version of the thesis within 15 days, he/she will be levied a fine prescribed by the University at the time of sending the proposal for result declaration.

23. Internship during Masters Programme

Internship for Development of Entrepreneurship in Agriculture (IDEA)

Currently, a provision of 30 credits for dissertation work in M.Sc. programmes helps practically only those students who aspire to pursue their career in academic/research. There is hardly any opportunity/provision under this system to enhance the entrepreneurship skills of those students who could start their own enterprise or have adequate skills to join the industry.

Therefore, in order to overcome this gap, an optional internship/ in-plant training (called as IDEA) in lieu of thesis/ research work is recommended which will give the students an opportunity to have a real-time hands-on experience in the industry. It is envisaged that the internship/ in-plant training would enhance the interactions between academic organizations and the relevant industry. It would not only enable the development of highly learned and skilled manpower to start their-own enterprises but also the industry would be benefitted through this process. This pragmatic approach would definitely result in enhanced partnerships between academia and industry.

The main objectives of the programme:

1. To promote the linkages between academia and industry
2. To establish newer University – Cooperative R&D together with industry for knowledge creation, research and commercialization
3. Collaboration between Universities and industries through pilot projects
4. To develop methods for knowledge transfer, innovation and networking potential
5. To enhance skill, career development and employability

Following criteria for IDEA will be taken into consideration:

- At any point of time there will not be more than 50% of students who can opt under IDEA
- Major Adviser will be from Academia and Co-advisor (or Advisory Committee member) from industry
- Total credits (30) will be divided into 20 for internship/ in-plant training and 10 for writing the report followed by viva-voce, similar to thesis research
- Work place will be industry; however, academic/ research support would be provided by the University or both. MoU may be developed accordingly
- The IPR, if any, would be as per the University policy

24. Result notification

24.1. After the completion of each semester, the student will be given the statement of marks by the Controller of Examinations.

24.2. The transcript will be prepared by Controller of Examinations. The various subjects taken by a student along with the credits and the grade obtained shall be shown on his/her transcript. Based on the total credits admitted, the final Grade Point Average shall be calculated and given.

25. Award of Medals

Medal should be awarded only if the student is a rank holder and secures at least 8.5 OGPA, clears all courses in first attempt and in the programme having a batch of at least three students.

26. Transitory Regulations

Separate time table of course work under old semester system will be arranged by the HOD. for students with attendance deficiency in a course/courses provided such course/courses are not currently offered due to the introduction of the revised syllabi with effect from the academic year 2022 – 2023. The candidates under old semester system will, however, complete all the examinations within a period of four academic years from the year of admission.

27. Removal of difficulties

If any difficulty arises in giving effect to the provisions of these regulations, based on the recommendations of the Dean, the Vice-Chancellor may issue necessary orders, which appear to him to be necessary or expedient for removing the difficulty.

GPAT 21 M.Sc. (Ag.) Plant Pathology

Courses with Credit

I) Course work	Credit
Major Courses	20
Minor Courses	08
Supporting Courses	06
Common Courses	05
Seminar	01
II) Thesis Research / IDEA	30
Total credits	70

Distribution Pattern of Courses and Credit (Research)

Semester	Major Courses	Minor Courses	Supporting Courses	Common Compulsory Courses	Seminar	Research	Credit
I	8	-	6	2	-	2	18
II	12	-	-	2	-	6	20
III	-	6	-	1	1	10	18
IV	-	2	-	-	-	12	14
Credit Load	20	8	6	5	1	30	70

Distribution Pattern of Courses and Credit (IDEA)

Semester	Major Courses	Minor Courses	Supporting Courses	Common Compulsory Courses	Seminar	IDEA	Credit
I	8	-	6	2	-	-	16
II	12	-	-	2	-	-	14
III	-	6	-	1	1	10	18
IV	-	2	-	-	-	10 +10	22
Credit Load	20	8	6	5	1	30	70

Distribution Pattern of Courses and Credit

S.no.	Course Code	Course Title	Credit Hours
Major Courses			
1	PAT 501*	Mycology	3 (2+1)
2	PAT 502*	Plant Virology	3 (2+1)
3	PAT 503*	Plant Pathogenic Prokaryotes	3 (2+1)
4	PAT 504*	Diseases of Field and Medicinal Crops	3 (2+1)
5	PAT 505	Plant Nematology	3(2+1)
6	PAT 506	Principles of Plant Pathology	3(2+1)
7	PAT 507	Techniques in Detection and Diagnosis of Plant Diseases	2(0+2)
8	PAT 508	Principles of Plant Disease Management	3(2+1)
9	PAT 509	Epidemiology and Forecasting of Plant Diseases	1(1+0)
10	PAT 510	Ecology of Soil-borne Plant Pathogens	2(1+1)
11	PAT 511	Integrated Disease Management	3(2+1)
12	PAT 512	Diseases of Fruits, Plantation and Ornamental Crops	3(2+1)
13	PAT 513	Diseases of Vegetable and Spices Crops	3(2+1)
14	PAT 514	Plant Quarantine and Regulatory Measures	1(1+0)
Minor Courses			
15	PAT 515	Disease Resistance in Plants	2(2+0)
16	PAT 516	Chemicals and Botanicals in Plant Disease Management	3(2+1)
17	PAT 517	Detection and Management of Seed Borne Pathogens	3(2+1)
18	PAT 518	Biological Control of Plant Diseases	2(1+1)
19	PAT 519	Post-Harvest Diseases	3(2+1)
Supporting Courses			
20	STA 501	Statistical Methods for Applied Sciences	3(2+1)
21	COM 501	Information Technology in Agriculture	3(2+1)
Common Compulsory Courses			
22	PGS 501	Library and information services	1(0+1)
23	PGS 502	Technical writing and communications skills	1(0+1)
24	PGS 503	Intellectual Property and its Management in Agriculture	1(1+0)
25	PGS 504	Basic Concepts in Laboratory Techniques	1(0+1)
26	PGS 505	Agricultural research, research ethics and rural development programmes	1(1+0)
Non Gradual Courses			
27	NGC 511	Disaster Management (Contact hour: 1)	-
28	NGC 512	Constitution of India (Contact hour: 1)	-
29	VAC	Value added course	-
30	PAT 591	Master's Seminar	1(0+1)
31	PAT 596/ 597/598/599	Research / IDEA	30

*Compulsory major courses

Programme Outcome (PO)

1. Will have high research capabilities and superior teaching skills in the field of Plant Pathology
2. Have clear knowledge on classification of phyto-pathogens and their physiological Interactions between plants up to molecular level
3. Have awareness on the Epidemiological aspects of Plant Pathology and acquire the knowledge of all the new innovative methodologies to manage plant diseases
4. Become an expert in Detection and diagnosis of pathogens/diseases in different crops
5. Be highly trained to successfully run Plant Health clinics and become a successful entrepreneur in the society

PO and CO Mapping Matrix

AFFINITY LEVEL	
1	Low
2	Moderate/ Medium
3	Substantial /High

SEMESTER WISE DISTRIBUTION OF COURSES (RESEARCH)

Sl. No.	Course Title	Credit hours
I Semester		
1.	Major Courses	8
2.	Supporting Courses	
	STA 501 - Statistical Methods for Applied Sciences	3
	COM 501 - Information Technology in Agriculture	3
3.	Common Compulsory Courses	
	PGS 501 - Library and information services	1
	PGS 502 - Technical writing and communications skills	1
4.	PAT 596 Research	2
	Total	18
II Semester		
1.	Major Courses	12
2.	Common Compulsory Courses	
	PGS 503 - Intellectual Property and its Management in Agriculture	1
	PGS 504 - Basic Concepts in Laboratory Techniques	1
3.	PAT 597 Research	6
	Total	20
III Semester		
1.	Minor courses	6
2.	Common Compulsory Courses	
	PGS 505 - Agricultural research, research ethics and rural development programmes	1
3.	Disaster Management (1+ 0)	-
4.	Constitution of India (Contact hour 1+ 0)	-
5.	PAT 591 Master's Seminar	1
6.	PAT 598 Research	10
7.	Value Added Course (3+0) (https://annamalaiuniversity.ac.in/studport/value_added_crs.php)	-
	Total	18
IV Semester		
1.	Minor course	2
2.	PAT 599 Research	12 (8+4)
	Total	14

SEMESTER WISE DISTRIBUTION OF COURSES (IDEA)

Sl. No.	Course Title	Credit hours
I Semester		
1.	Major Courses	8
2.	Supporting Courses	
	STA 501 - Statistical Methods for Applied Sciences	3
	COM 501 - Information Technology in Agriculture	3
3.	Common Compulsory Courses	
	PGS 501 - Library and information services	1
	PGS 502 - Technical writing and communications skills	1
4.	PAT 596 IDEA	
	Total	16
II Semester		
4.	Major Courses	12
5.	Common Compulsory Courses	
	PGS 503 - Intellectual property and its management in agriculture	1
	PGS 504 - Basic Concepts in Laboratory Techniques	1
6.	PAT 597 IDEA	
	Total	14
III Semester		
1.	Minor courses	6
2.	Common Compulsory Courses	
	PGS 505 - Agricultural research, research ethics and rural development programmes	1
3.	Disaster Management (1+ 0)	-
4.	Constitution of India (Contact hour 1+ 0)	-
5.	PAT 591 Master's Seminar	1
6.	PAT 598 IDEA	10
7.	Value Added Course (3+0) (https://annamalaiuniversity.ac.in/studport/value_added_crs.php)	-
	Total	18
IV Semester		
1.	Minor course	2
2.	PAT 599 IDEA	20 (10+10)
	Total	22

PAT 501 MYCOLOGY (2+1)

Learning objectives

- To study the somatic characters and reproduction in fungi
- To study the nomenclature and taxonomic classification of plant pathogenic fungi
- To study the general characters and life cycle of Oomycetes and Ascomycetous fungi
- To study the general characters and life cycle of Basidiomycetes fungi
- To get acquainted with the molecular characterization of Plant Pathogenic fungi

Unit I

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi.

Unit II

Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists. The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota.

Unit III

Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota. Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota,

Unit IV

Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi. Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes

Unit V

Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi.

Theory lecture schedule

1. Introduction, definition of different terms, basic concepts
2. Importance of mycology in agriculture, relation of fungi to human affairs
3. History of mycology
4. Importance of culture collection and herbarium of fungi
5. Somatic characters in fungi
6. Reproduction in fungi
7. Reproduction in fungi
8. Modern concept of nomenclature and classification
9. Classification of kingdom fungi: Stramenopila and Protists
10. The general characteristics of protists
11. Life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota
12. Life cycle in the Phyla Acrasiomycota and Myxomycota
13. General characters and life cycles of different genera under Hypochytriomycota and Labyrinthulomycota

14. General characters and life cycles of respective genera under Oomycota
15. Life cycles of respective genera under Oomycota
16. General characters of Kingdom fungi
17. Mid semester examinations
18. Ultrastructure and life cycle patterns in representative genera under Chytridiomycota
19. Life cycle patterns in representative genera under Zygomycota
20. General characters of representative genera under Ascomycota
21. Life cycle in the class Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes
22. Life cycle in the class Plectomycetes, Discomycetes and Loculoascomycetes,
23. Classification of powdery mildew fungi
24. Types of ascocarps
25. Life cycle in the order Erysiphales
26. Anamorphs of ascomycetous fungi
27. Basidiomycota; general characters, mode of reproduction
28. Types of basidiocarps and Economic importance of Hymenomycetes
29. Uridinales and Ustilaginales; variability, host specificity
30. Life cycle pattern in rust fungi
31. Life cycle pattern in smut fungi
32. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships
33. Molecular characterization of plant pathogenic fungi
34. Molecular characterization of plant pathogenic fungi

Practical schedule

1. Types of asexual fruiting bodies produced by fungi
2. Types of sexual fruiting bodies produced by fungi
3. Plasmodiophoromycota, Dictyosteliomycota
4. Pythium, Phytophthora and Albugo
5. Plasmopara, Peronospora, Pseudoperonospora, Bremia, Sclerospora and Peronosclerospora
6. Zygomycota
7. Saccharomyces and Taphrina
8. Discomycetes and Loculoascomycetes
9. Erysiphe, Leveillula, Phyllactinia and Uncinula
10. Sclerotinia, Claviceps, Gibberella, Glomerella
11. Agaricus, Pleurotus, Volvariella, Ganoderma
12. Puccinia, Uromyces and Hemelia
13. Ustilago, Sporisorium and Exobasidium
14. Culturing of respective genus
15. Microscopic examination of generic level of taxonomic key for important plant pathogenic fungi
16. Microscopic examination of generic level of taxonomic key for important plant pathogenic bacteria
17. Collection of cultures and live specimens

Course outcome:

- CO1:** Having knowledge about the general characters and reproduction in fungi.
CO2: Being updated with recent taxonomic classification of fungi
CO3: Having expertise in species level identification of fungi.
CO4: Having knowledge about important life cycle of plant pathogens
CO5: Having in depth knowledge of molecular characterization of Plant Pathogenic fungi

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	-	-
CO2	2	3	1	-	-
CO3	2	3	1	-	-
CO4	1	2	1	3	2
CO5	1	2	1	1	-

Suggested readings

1. Aneja, K.R. and Mehrotra, R.S.2019. An Introduction to Mycology (Second Edition). New Age International Publishers.
2. Inderjeet Kaur Sethi and Surinder Kaur Walia. 2018. Textbook of Fungi and Their Allies. Textbook of Fungi and their allies. Medtech Publishers.
3. Gopinath Hait. 2017. A Textbook of Mycology. New Central Book Agency (NCBA).
4. Dube, H.C. 2012. An Introduction to Fungi.4th Edition. Scientific Publishers, New Delhi.
5. John Webster and Roland S Weber. 2007. Introduction to Fungi. Third Edition. Cambridge University Press.

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1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3348774/pdf/ima-1-2-123.pdf>
2. <https://www.frontiersin.org/articles/10.3389/fmicb.2018.00503/pdf>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3764329/pdf/fphys-04-00244.pdf>
4. https://www.ars.usda.gov/ARSUserFiles/3094/rust_fungi.pdf
5. <https://www.frontiersin.org/articles/10.3389/fcimb.2020.600234/pdf>

PAT 502 PLANT VIROLOGY (2+1)**Learning objectives**

- To study the morphological and molecular structure of plant viruses
- To know the taxonomy and nomenclature of plant viruses
- To learn about the transmission of viruses and the virus vector relationship
- To acquaint with the molecular detection and identification of plant viruses
- To study about engineering resistance to plant viruses and plant viral disease management

Unit I

History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and baculo viruses, satellite viruses, satellite RNAs, phages, viroids and prions

Unit II

Origin and evolution of viruses and their nomenclature and classification. Genome organization, replication in selected groups of plant viruses and their movement in host

Unit III

Response of the host to virus infection: biochemical, physiological, and symptomatic changes. Transmission of viruses and virus-vector relationship

Unit IV

Isolation and purification of viruses: clarification, concentration, centrifugation, high resolution separation and analysis of virions. Detection and identification of plant viruses by using protein, nucleic acid and serological based. (Non-PCR–LAMP) Lateral flow micro array, PCR based techniques and ELISA

Unit V

Natural (R-genes) and engineering resistance to plant viruses: Cross protection, transgene mediated resistance, transgenic resistance mediated viral coat protein, transgene mediated RNA silencing. Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses

Theory Lecture Schedule

1. History and economic significances of plant viruses.
2. General characters of viruses
3. Morphological characters of viruses
4. Composition of viruses
5. Structure of viruses.
6. Myco-viruses
7. Arboviruses
8. Baculoviruses
9. Satellite viruses
10. Satellite RNAs
11. Phages
12. Viroids
13. Prions
14. Origin and evolution of viruses
15. Nomenclature and classification of viruses I
16. Nomenclature and classification of viruses II
17. Mid semester Examination
18. Virus Genome organization
19. Virus replication in selected groups of plant viruses
20. Virus movement in host
21. Response of the host to virus infection: Biochemical changes.
22. Response of the host to virus infection: Physiological changes.
23. Response of the host to virus infection: Symptomatic changes.
24. Transmission of viruses

25. Virus-vector relationship.
26. Isolation of viruses
27. Purification of viruses
28. Detection and identification of plant viruses by using protein based diagnostic techniques.
29. Detection and identification of plant viruses by using nucleic acid based diagnostic techniques.
30. Natural (R-genes) Cross protection, transgene mediated resistance
31. Transgenic resistance mediated viral coat protein, transgene mediated RNA silencing.
32. Virus epidemiology
33. Virus ecology (spread of plant viruses in fields, host range and survival).
34. Management of diseases caused by plant viruses

Practical schedule

1. Study of symptoms caused by plant viruses
2. Field visit
3. Isolation of viruses
4. Biological purification of plant virus cultures
5. Bioassay of virus cultures on indicator plants and host differentials
6. Mechanical Transmission of plant viruses
7. Graft Transmission of plant viruses
8. Vector Transmission of plant viruses
9. Study of disease development
10. Plant virus purification (clarification, concentration)
11. Centrifugation, high resolution separation and analysis of virions
12. Electron microscopy for studying viral particle morphology
13. Antisera production
14. Detection and diagnosis of plant viruses with serological (ELISA)
15. nucleic acid (Non-PCR–LAMP)
16. Later flow micro array and PCR based techniques
17. Exposure to basic bio-informatic tools for viral genome analysis and their utilization in developing detection protocols and population studies (BLASTn tool, Primer designing software, Bioedit tool, Clustal X/W, MEGA Software)

Course outcome:

- CO 1:** Having knowledge about the significances of plant viruses, their structure and Virus-related organisms
- CO 2:** Having in depth information about taxonomy and nomenclature of viruses, their genome structure and their replication and movement in hosts
- CO 3:** Being aware of the host response to the biochemical, physiological and symptomatic changes due to virus infection and transmission of viruses through their vectors
- CO 4:** Acquainted with the molecular detection and identification of plant viruses
- CO 5:** Expertise in engineering resistance to plant viruses and Integrated Plant Viral disease management

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	-	-	-	-
CO 2	2	3	-	-	-
CO 3	3	-	1	3	2
CO 4	3	-	-	3	2
CO 5	3	2	3	2	3

Suggested readings

1. Awasthi L.P. 2020. Applied Plant Virology: Advances, Detection, and Antiviral Strategies. Academic Press.
2. Roger Hull 2013. Plant Virology, Fifth Edition. Academic Press.
3. Kolte S. J and Tewari A. K. 2011. The elements of plant virology. Basic concepts and practical class exercises. Kalyani Publishers., New Delhi.
4. Roger Hull 2009. Comparative Plant Virology Academic Press.
5. Walkey D. G. 1990. Applied Plant Virology Second Edition Springer

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2. <https://www.sciencedirect.com/science/article/pii/S0042682215000379/pdffft?md5=23923b204582fa21b0023f264d947e5c&pid=1-s2.0-S0042682215000379-main.pdf>
3. <https://www.sciencedirect.com/science/article/pii/S2468014121000662/pdffft?md5=3d3882b08d268288024ee57a959655bb&pid=1-s2.0-S2468014121000662-main.pdf>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6139301/pdf/fmicb-09-02087.pdf>
5. <https://www.sciencedirect.com/science/article/pii/S0042682215001622/pdffft?md5=638610b063b653bca5b6d4719a30435a&pid=1-s2.0-S0042682215001622-main.pdf>

PAT 503 PLANT PATHOGENIC PROKARYOTES (2+1)

Learning objectives

- To know the history, evolution, morphology and composition of phytopathogenic Prokaryotes.
- To study mechanism of infection, survival and dispersal of phytopathogenic Prokaryotes.
- To learn about the Taxonomy of Phytopathogenic Prokaryotes.
- To know the variability and horizontal gene transfer.
- To study the classification of phages and get acquainted with the management of diseases caused by Phytopathogenic prokaryotes

Unit- I Prokaryotic cell

History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and gram-positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccharide structure; Membrane transport; fimbriae and pili (Type- IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial

movement; Glycocalyx (Slayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas.

Unit- II Growth and Nutritional requirements

Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of Phytopathogenic prokaryote

Unit –III Taxonomy of Phytopathogenic prokaryota

Taxonomic ranks hierarchy; Identification, Classification and Nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of Phytopathogenic prokaryotes.

Unit- IV Variability among Phytopathogenic prokaryota

General mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria conjugation; transformation; transduction) and horizontal gene transfer.

Unit V- Bacteriophages, L form of bacteria, plasmids and Bdellovibrios

Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by Phytopathogenic prokaryotes.

Theory lecture schedule

1. History and development of Plant bacteriology.
2. History of plant bacteriology in India.
3. Evolution of prokaryotic life.
4. Prokaryotic cytoskeletal proteins.
5. Structure of bacterial cell.
6. Structure and composition of gram-negative and gram-positive cell wall.
7. synthesis of peptidoglycan; Surface proteins; Lipopolysaccharide structure.
8. Membrane transport; fimbriae and pili (Type- IV pili).
9. Mechanism of Flagellar rotatory motor.
10. locomotion, and bacterial movement.
11. Glycocalyx (Slayer; capsule).
12. The bacterial chromosomes and plasmids.
13. Operon and other structures in cytoplasm.
14. Morphological feature of fastidious bacteria.
15. Morphological feature of spiroplasmas and Phytoplasmas.
16. Infection mechanism, role of virulence factors in expression of symptoms.
- 17. Mid semester examination**
18. Survival and dispersal of Phytopathogenic prokaryotes.
19. Taxonomic ranks hierarchy.
20. Identification, Classification and nomenclature of bacteria.
21. Identification, Classification and nomenclature of Phytoplasma

22. Identification, Classification and nomenclature of Spiroplasma.
23. The codes of Nomenclature and characteristics.
24. Biochemical and molecular characterization of Phytopathogenic prokaryotes.
25. General mechanism of variability (mutation)
26. specialized mechanisms of variability (Conjugation; Transformation; Transduction)
27. Horizontal gene transfer.
28. Structure; Infection of host cells; phage multiplication cycle.
29. Classification of phages.
30. Use of phages in plant pathology/ bacteriology, Lysogenic conversion.
31. H Plasmids and their types.
32. Plasmid borne phenotypes.
33. Introduction to Bacteriocins.
34. Strategies for management of diseases caused by Phytopathogenic prokaryotes.

Practical

Study of symptoms produced by Phytopathogenic Prokaryotes- Isolation, Enumeration and Purification methods- Identification and host inoculation of Phytopathogenic bacteria- Preparation of Stains and bacterial smears- Endospore and capsule staining- Biochemical and serological characterization- Isolation of genomic DNA plasmid. Plasmid profiling of bacteria- Use of antibacterial chemicals/ antibiotics-Isolation of fluorescent Pseudomonas-Preservation of bacterial cultures- Test for secondary metabolite, cyanides and EPS- Bacteriocin and Siderophore production- Fatty acid profiling of bacteria- RFLP profiling of bacteria and variability- Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences-Diagnosis and management of important diseases caused by bacteria and Mollicutes.

Practical schedule

1. Study of symptoms produced by Phytopathogenic prokaryotes.
2. Isolation of Phytopathogenic bacteria- Enumeration and Purification methods.
3. Identification and host inoculation of Phytopathogenic bacteria.
4. Preparation of Stains and bacterial smears.
5. Endospore and capsule staining.
6. Biochemical and serological characterization.
7. Isolation of genomic DNA plasmid.
8. Plasmid profiling of bacteria.
9. Use of antibacterial chemicals/ antibiotics.
10. Isolation of fluorescent Pseudomonas.
11. Preservation of bacterial cultures.
12. Test for secondary metabolite, cyanides and EPS.
13. Bacteriocin and Siderophore production.
14. Fatty acid profiling of bacteria.
15. RFLP profiling of bacteria and variability.
16. Identification of prokaryotic organisms using 16S rDNA, and other gene sequences.
17. Diagnosis and management of important diseases caused by Bacteria and Mollicutes.

Course outcome:

- CO1:** Having knowledge about the history, evolution, morphology of Phyto- pathogenic prokaryotes.
- CO2:** Acquainted with the mechanism of infection and pathogenesis
- CO3:** Knowing the Taxonomy and nomenclature of plant pathogenic prokaryotes
- CO4:** Updating knowledge about the variability and sexual process of prokaryotes diseases
- CO5:** Being aware of the emerging plant pathogenic prokaryote diseases and their integrated disease management

CO – PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	-	1	-
CO 2	1	3	-	-	2
CO 3	-	2	-	-	1
CO 4	1	3	-	2	-
CO 5	2	-	2	3	1

Suggested readings

1. Suresh G Borkar 2017. Laboratory Techniques in Plant Bacteriology. CRC Press.
2. Kalyan k Mondal 2011. Plant Bacteriology, Kalyani Publishers
3. Jacob Janse. 2006. Phytobacteriology Principles and Practice. CABI Publications
4. Jayaraman J and Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana.
5. Goto Masao. 1990. Fundamentals of Bacterial Plant Pathology. Academic Press.

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3. <https://bsppjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/mpp.12427>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6638335/pdf/MPP-17-1298.pdf>
5. <https://www.frontiersin.org/articles/10.3389/fmicb.2017.00034/pdf>

PAT 504 -DISEASES OF FIELD AND MEDICINAL CROPS (2+1)**Learning objectives**

- To acquire knowledge on etiology, symptoms, epidemiology and management of diseases of cereals and millets
- To acquire knowledge on etiology, symptoms, epidemiology and management of diseases of pulses
- To acquire knowledge on etiology, symptoms, epidemiology and management of diseases of oilseeds

- To acquire knowledge on etiology, symptoms, epidemiology and management of diseases of cash crops and fodder legumes
- To acquire knowledge on etiology, symptoms, epidemiology and management of diseases of medicinal crops

Unit I - Diseases of Cereals, millets and their management

Symptoms, etiology, disease cycle and management of major diseases of rice, wheat, barley, pearl millet, sorghum and maize

Unit II: Diseases of Pulses and their management

Symptoms, etiology, disease cycle and management of major diseases gram, urdbean, mungbean, lentil, pigeonpea, soybean and cowpea

Unit III: Diseases of Oilseed and their management

Symptoms, etiology, disease cycle and management of major diseases of rapeseed and mustard, sesame, linseed, sunflower, groundnut and castor

Unit IV: Diseases of Cash crops, Fodder legume crops and their management

Symptoms, etiology, disease cycle and management of major diseases of cotton, sugarcane, Berseem, oats, guar and lucerne

Unit V: Diseases of Medicinal crops and their management

Symptoms, etiology, disease cycle and management of major diseases *Plantago*, liquorice, mulathi, rosagrass, sacred basil, mentha, ashwagandha, *Aloe vera*.

Theory lecture schedule

1. Introduction to field crop diseases and their significance
2. Diseases of Rice
3. Diseases of Rice
4. Diseases of Wheat
5. Diseases of Wheat
6. Diseases of Barley
7. Diseases of Finger millet
8. Diseases of Sorghum
9. Diseases of Maize
10. Diseases of Maize
11. Diseases of Gram
12. Diseases of Urdbean
13. Diseases of Mungbean
14. Diseases of Lentil
15. Diseases of Pigeonpea
16. Diseases of Soyabean
- 17. Mid-semester examination**
18. Diseases of Cowpea

19. Diseases of Rapeseed & Mustard
20. Diseases of Sesame & Linseed
21. Diseases of Sunflower
22. Diseases of Groundnut
23. Diseases of Castor
24. Diseases of Cotton
25. Diseases of Sugarcane
26. Diseases of Berseem & Oats
27. Diseases of gaur & Lucerne
28. Diseases of *Plantago*
29. Diseases of *Liquorice*
30. Diseases of Rosagrass
31. Diseases of Sacred basil
32. Diseases of Mentha
33. Diseases of Ashwagandha
34. Diseases of *Aloe vera*

Practical schedule

Study of symptoms and host-parasite relationship of:

1. Diseases of Rice
2. Diseases of Wheat
3. Diseases of Barley & Finger millet
4. Diseases of Sorghum & Maize
5. Diseases of Gram, Urdbean, Mungbean
6. Diseases of Lentil & Pigeon pea
7. Diseases of Soyabean & Cowpea
8. Diseases of Rapeseed, Mustard, Sesame
9. Diseases of Linseed & Sunflower
10. Field visit/exposure visit to cereals, pulses & oilseed crops
11. Diseases of Groundnut & Castor
12. Diseases of Cotton
13. Diseases of Sugarcane
14. Diseases of Berseem, Oats, gaur & Lucerne
15. Diseases of *Plantago*, *Liquorice*, Rosagrass
16. Diseases of Sacred basil, Mentha, Ashwagandha, *Aloe vera*
17. Record Certification & Final Practical examination

Assignment: Students should submit 50 well-pressed diseased specimens.

Course outcome:

CO1: Acquired knowledge about diseases of cereal crops and their management

CO2: Acquired knowledge about diseases of pulse crops and their management

CO3: Acquired knowledge about diseases of oil seed crops and their management

CO4: Acquired knowledge about diseases of cash crops and fodder legume crops and their management

CO5: Acquired knowledge about diseases of medicinal crops and their management

CO-PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	-	1	1
CO2	2	3	-	1	1
CO3	2	3	-	1	1
CO4	2	3	-	1	1
CO5	2	3	-	1	1

Suggested readings

1. Dubey S.C., Rashmi Aggarwal, Patro T.S.S.K. and Pratibha Sharma. 2016. Diseases of Field Crops. Indian Phytopathological Society/ Today's and Tomorrow Publishers.
2. Rakesh Pandey, Misra A.K., Alok Kalra, Singh H.B. and Dinesh Singh. 2019. Diseases of Medicinal and Aromatic Plants Aromatic and their Management. Indian Phytopathological Society/ Today's and Tomorrow Publishers.
3. Srivastava J N and Singh A K. 2022. Diseases of Field Crops Diagnosis and Management: Volume 1: Cereals, Small Millets, and Fiber Crops. Apple Academic Press.
4. Srivastava J N and Singh A K. 2022. Diseases of Field Crops Diagnosis and Management: Volume 2: Pulses, Oil Seeds, Narcotics, and Sugar Crops. Apple Academic Press.
5. Chakrabarti D K 2019. Text Book on Diseases of Field Crops. Narendra Publishing House

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2. <https://phytopatholres.biomedcentral.com/track/pdf/10.1186/s42483-020-00067-6.pdf>
3. https://www.researchgate.net/profile/Sajad-Un-Nabi-2/publication/290471049_Overview_on_a_century_progress_in_research_on_sesame_phyllody_disease/links/56c7eaa808ae5488f0d2ec42/Overview-on-a-century-progress-in-research-on-sesame-phyllody-disease.pdf

4. https://www.researchgate.net/profile/Rishu-Sharma/publication/330080661_Major_diseases_of_castor_and_their_management/links/5c2c5876299bf12be3a730a6/Major-diseases-of-castor-and-their-management.pdf
5. http://oar.icrisat.org/821/1/RA_00080.pdf

PAT 505 PLANT NEMATOLOGY (2+1)

Learning objectives

- To know the Characteristics of Phylum Nematoda and their economic importance in agriculture
- To know the morphology, biology, physiology and ecology of phytonematodes
- To study the parasitism type and their interaction with other organisms
- To understand the plant nematode relationships and physiological specialization of phytonematodes
- To acquaint with the principles and practices of integrated nematode management.

Unit I

Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry.

Unit II

Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology.

Unit III

Types of parasitism; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms.

Unit IV

Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes.

Unit V

Principles and practices of nematode management; integrated nematode management. Emerging nematode problems, Importance of nematodes in international trade and quarantine.

Theory Lecture schedule

1. Characteristics of Phylum Nematoda
2. Nematode relationship with other related phyla
3. History of nematology
4. Important milestones in the growth of nematology
5. Nematode habitats
6. Nematode as parasites in plants
7. Nematode as parasites in animals

8. Nematode diversity in human as parasites
9. Beneficial nematodes
10. Economic importance of nematodes in agriculture
11. Economic importance of nematodes in horticulture
12. Economic importance of nematodes in forestry.
13. Gross morphology of plant parasitic nematodes
14. Broad classification of nematodes
15. Nematode biology
16. Nematode physiology
17. Midsemester Examination
18. Nematode ecology
19. Types of parasitism by plant nematodes
20. Nature of damage by nematodes
21. General symptomatology by nematodes
22. Interaction of plant-parasitic nematodes with other organisms.
23. Plant nematode relationships
24. Cellular responses to infection by important phytonematodes
25. Physiological specialization among phytonematodes.
26. Principles of nematode management
27. Practices followed in nematode management
28. Integrated nematode management
29. Cultural methods
30. Biological methods
31. Chemical methods
32. Emerging nematode problems
33. Importance of nematodes in international trade
34. Quarantine measures adopted for plant parasitic nematodes

Practical Lecture Schedule

1. Studies on kinds of nematodes- free-living, animal, insect and plant parasites
2. Nematode symptomatology
3. Morphology of plant parasitic nematodes
4. Diseased specimens collection
5. Nematode extraction from soil
6. Extraction of migratory endoparasites
7. Staining for sedentary endoparasites
8. Examination of different life stages of important plant parasitic nematodes -I
9. Examination of different life stages of important plant parasitic nematodes -II
10. Histopathology of nematodes
11. Nematode pests of different crops-I
12. Nematode pests of different crops-II
13. Field visit
14. Nature of damage and symptomatology by nematodes
15. Nematode management practices
16. Field visit
17. Record certification

Course outcome:

- CO 1:** Knowing about the nematode habitats and diversity as plant parasites
- CO 2:** Having an in depth knowledge about the morphology, biology, physiology and ecology of phytonematodes
- CO 3:** Being aware of the symptomatology and parasitism type adopted by phytonematodes
- CO 4:** Having knowledge of the study the plant nematode relationships and physiological specialization of phytonematodes
- CO 5:** Expertise in practices of integrated nematode management

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	-	-	-	-
CO 2	2	2	-	-	-
CO 3	3	-	-	3	2
CO 4	3	-	-	3	2
CO 5	3	2	3	2	3

Suggested readings

1. Parvatha Reddy P. 2021. Nematode Diseases of Crops and their management. Springer.
2. Parvatha Reddy P. 2019. Introductory Plant Nematology. Scientific publishers.
3. Ravichandra N.G. 2019. Methods and Techniques in Plant Nematology. Prentice Hall India Publishing Limited
4. Walia RK and Khan MR. 2018. A Compendium of Nematode Diseases of Crop Plants, ICAR-AICRP (Nematodes), IARI, New Delhi.
5. Perry RN and Moens M. 2013. Plant Nematology. 2nd Ed. CABI Publishing: Wallingford, UK.

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4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8624893/pdf/plants-10-02352.pdf>
5. <https://www.frontiersin.org/articles/10.3389/fpls.2020.01125/pdf>

PAT 506 PRINCIPLES OF PLANT PATHOLOGY (2+1)

Learning objectives

- To acquaint with the concepts of plant diseases; biotic and abiotic causes of diseases
- To understand the growth, reproduction, survival and dispersal of important plant pathogens
- To study the host parasite interaction and pathogenesis in plants
- To study the defence strategies and changes in host after infection
- To learn the molecular basis for resistance and genetic engineering for disease resistance

Unit I

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, Basic concepts and principles to study of host pathogen relationship, Biotic and abiotic causes of plant diseases.

Unit II

Growth, reproduction, survival and dispersal of important plant pathogens, role of Environment: Effect of temperature, light, humidity, moisture, rain and drought – Micro climate and Macro climate – Host: Boom and Burst population growth cycle – Area under disease progress curve (AUDPC) – Different disease progress model and correction factors – Inoculum dynamics – Population biology of pathogens and host nutrition on disease development.

Unit III

Host parasite interaction, recognition of host by pathogens, concept of infection, entry of pathogen into host, mode of host penetration, appressorium, infection peg, symptomatology, inoculums; Pathogen offence- role of enzymes, toxins, growth regulators and polysaccharides - classification, mode of action, disease development

Unit IV

Defence strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. Physical and biochemical (preformed and post inflectional). ISR and SAR; Physiological changes in host after infection- photosynthesis, respiration, transpiration, translocation, absorption, transcription and translation, plant growth

Unit V

Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. Different methods of gene transfer, biosafety issues related to GM crops. vertical and horizontal resistance, tissue culture for disease resistance.

Theory lecture schedule

1. Introduction and historical development on Plant Pathology.
2. Importance, definitions and concepts of plant diseases.
3. Host pathogen relationship. Biotic and abiotic causes of plant diseases.
4. Basic concepts of plantpathogen relationship
5. Principlesof plantpathogen relationship
6. Growth, reproductionof important plant pathogens

7. Survival and dispersal of important plant pathogens
8. Effect of temperature, light, humidity, moisture, rain and drought on disease development
9. Effect of Microclimate and Macroclimate on development of disease.
10. Host: Boom and Burst cycle.
11. Area under disease progress curve (AUDPC).
12. Different disease progress model and correction factors.
13. Inoculum dynamics, population biology of pathogens.
14. Temporal spatial variability in plant pathogens.
15. Plant and pathogen nutrient acquisition strategies
16. Mechanisms of nutrient acquisition, utilization during pathogens infections of host
17. Mid-term examination
18. Host -pathogen interaction
19. Mode of host penetration, appressorium, infection peg, symptomatology.
20. Pathogen offence- role of enzymes, toxins, growth regulators and polysaccharides
21. Basic terms in resistance biology: pathogen virulence, aggressiveness, susceptibility, disease tolerance, disease resistance, local resistance, systemic resistance.
22. Defence strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors.
23. Host defence mechanisms, morphological and anatomical resistance.
24. Phytoanticipins and induced structural and biochemical defences.
25. Systemic acquired resistance
26. Induced systemic resistance
27. Physiological changes in host after infection- photosynthesis, respiration, transpiration, translocation, absorption, transcription and translation, plant growth.
28. R gene expression, transcription profiling
29. Biotechnology– Genetic engineering– gene transfer
30. Protein-for-protein, resistance (R) genes of plants, management of resistance genes.
31. Variability of Plant Pathogens
32. Molecular basis for resistance; marker-assisted selection;
33. Genetic engineering for disease resistance. Different methods of gene transfer, biosafety issues related to GM crops.
34. Vertical and horizontal resistance, tissue culture for disease resistance.

Practical schedule

1. Basic plant pathological techniques
2. Isolation, inoculation and purification of plant pathogens
3. Proving Koch's postulates
4. Different types of spore traps and collection of spores
5. Measuring disease intensity.
6. Techniques to study cultural and morphological variability in different plant pathogens.
7. Techniques to study molecular variability plant pathogens
8. Isolation, purification of enzymes.
9. Isolation, purification of toxins
10. Estimation of phenolics, phytoalexins.
11. Estimation of PR proteins, elicitors.

12. Estimation of phytoalexins.
13. Different methods of gene transfer to GM crop
14. Plant tissue culture–genetic engineering.
15. Plant tissue culture–genetic engineering
16. Bacterial transformation
17. Record Certification

Course outcome:

- CO 1:** Having knowledge about host pathogen relationship and biotic and abiotic causes of plant diseases.
- CO 2:** Having knowledge about the effect of environmental factors, development of the diseases. Microclimate and Macroclimate.
- CO 3:** Being aware of host parasite interaction, pathogen offence- role of enzymes, toxins, growth regulators and polysaccharides
- CO 4:** Updated knowledge about defence strategies: phenolics, phytoalexins, PR proteins, elicitors
- CO 5:** Acquainted with vertical and horizontal resistance, genetic engineering for disease resistance.

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	1	1	3	1
CO 2	3	2	2	2	2
CO 3	2	2	2	1	-
CO 4	3	3	2	2	2
CO 5	1	2	1	2	-

Suggested reading

1. Singh RS. 2017. Introduction to Principles of Plant Pathology. 5th edition. MedTech, New Delhi.
2. Chaube H.S.2020. Introductory Plant Pathology. CBS Publishers
3. Anne Marte Tronsmo, David B. Collinge, Annika Djurle, Lisa Munk, Jonathan Yuen, Arne Tronsmo 2020. Plant Pathology and Plant Diseases. CABI Publications.
4. John A. Lucas 2020. Plant Pathology and Plant Pathogens 4th edition. Wiley-Blackwell.
5. Swapan K. Datta 1999. Pathogenesis-Related Proteins in Plants. CRC Press.

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4. <https://www.frontiersin.org/articles/10.3389/fmicb.2017.01451/pdf>
5. <https://www.sciencedirect.com/science/article/pii/S1674205220303130/pdf?md5=a8bf1c9bd08d35eb82455be3b1e920aa&pid=1-s2.0-S1674205220303130-main.pdf>

PAT 507 TECHNIQUES FOR DETECTION AND DIAGNOSIS OF PLANT DISEASES (0+2)

Learning objectives

- To acquire knowledge on early detection of diseases/ pathogens,
- To acquaint with biochemical methods of disease diagnosis.
- To acquaint with the latest techniques in diagnosing diseases.
- To educate about the advanced molecular techniques and new developments in diagnosing diseases
- To get trained on the use of novel instruments in disease diagnosis.

Unit-I

Detection of plant pathogens 1. Based on visual symptoms, 2. Biochemical test 3. Using microscopic techniques, 4. Cultural studies; (use of selective media to isolate pathogens). 5. Biological assays (indicator hosts, differential hosts) 6. Serological assays 7. Nucleic acid-based techniques (Non-PCR-LAMP, Later flow microarray and PCR based- multiplex, nested, qPCR, immune capture PCR, etc.);

Unit-II

Phenotypic and genotypic tests for identification of plant pathogens

Unit-III

Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; and eukaryotic organism by ITS region) and whole genome sequencing;

Unit-IV

Volatile compounds profiling by using GC-MS and LC-MS; FAME analysis, Fluorescence *in-situ* Hybridization (FISH), Flow Cytometry, Phage display technique, biosensors for detection of plant pathogens;

Unit-V

Genotypic tools such as genome/ specific gene sequence homology comparison by BLAST (NCBI and EMBL) and electron microscopy techniques of plant virus detection and diagnosis.

Practical schedule

1. Detection of plant pathogens based on visual symptoms
2. Biochemical test to detect fungal diseases
3. Biochemical test to detect bacterial and viral diseases
4. Using microscopic techniques to detect fungal pathogens
5. Using microscopic techniques to detect bacterial pathogens

6. Cultural studies; (use of selective media to isolate pathogens)
7. Biological assays (indicator hosts)
8. Biological assays (differential hosts)
9. Serological assays
10. Indirect ELISA
11. Sandwich ELISA
12. Nucleic acid-based techniques -Non-PCR–LAMP
13. Later flow microarray
14. PCR based- multiplex, nested
15. qPCR, immune capture PCR
16. Phenotypic tests for identification of plant pathogens
17. Mid semester examination
18. Phenotypic tests for identification of plant pathogens
19. Genotypic tests for identification of plant pathogens
20. Genotypic tests for identification of plant pathogens
21. Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; by ITS region)
22. Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences- eukaryotic organism by ITS region)
23. Genome sequencing
24. Genome sequencing
25. Volatile compounds profiling by using GC-MS
26. Volatile compounds profiling by using LC-MS
27. Volatile compounds profiling by using FAME analysis
28. Fluorescence *in-situ* Hybridization (FISH) for detection of plant pathogens
29. Flow Cytometry for detection of plant pathogens,
30. Phage display technique for detection of plant pathogens
31. Biosensors for detection of plant pathogens
32. Biosensors for detection of plant pathogens
33. Genotypic tools such as genome/ specific gene sequence homology comparison by BLAST (NCBI and EMBL)
34. Electron microscopy techniques of plant virus detection and diagnosis.

Course outcome:

- CO1:** Gaining knowledge on early detection of diseases/ pathogens,
CO2: Acquainted with biochemical methods of disease diagnosis.
CO3: Acquainted with the latest techniques in diagnosing diseases.
CO4: Acquired knowledge of advanced molecular techniques and new developments in diagnosing diseases
CO5: Trained to use the novel instruments in disease diagnosis.

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	-	-	3	2
CO 2	1	-	-	3	2
CO 3	-	-	-	3	2
CO 4	3	-	-	3	2
CO 5	3	-	-	3	2

Suggested readings

1. Boonham N., Tomlinson J., Mumford R. 2016. Molecular Methods in Plant Disease Diagnostics: Principles and Protocols. CABI Publications
2. Narayanasamy P. 2014. Microbial Plant Pathogens-Detection and Disease Diagnosis: Fungal Pathogens, Vol.1. Springer
3. Narayanasamy P. 2014. Microbial Plant Pathogens-Detection and Disease Diagnosis: Bacterial and Phytoplasmal Pathogens, Vol.2. Springer
4. Narayanasamy P. 2001. Plant Pathogen Detection and Disease Diagnosis 2nd edition. CRC Press
5. Narayanasamy P. 2016. Microbial Plant Pathogens: Detection and Management in Seeds and Propagules. Wiley Science.

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4. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/epp.12541>
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PAT 508 PRINCIPLES OF PLANT DISEASE MANAGEMENT (2+1)

Learning objectives

- To acquaint with different strategies for management of plant diseases.
- To be aware of the chemical and molecular approach for plant disease management
- To understand the mode of action of new generation fungicides and methods of application of chemicals
- To get acquainted with the evaluation of chemicals, antibiotics, bio agents against plant pathogens
- To get acquainted with the plant protection appliances and environmental hazards produced by fungicides

Unit I

Principles of plant disease management by cultural, physical, biological, chemical. Organic amendments and botanicals, integrated control measures of plant diseases. Disease resistance

Unit II

Molecular approach for disease management. History of fungicides, bactericides, antibiotics- concepts of pathogen, immobilization, chemical protection and chemotherapy, nature.

Unit III

Properties and mode of action of antifungal, antibacterial and antiviral chemicals. Label claim of fungicides. Methods of application of chemicals, antibiotics and bio-agents

Unit IV

Phytopathometry - Methods of *in-vitro* evaluation of chemicals, antibiotics, bio agents against plant pathogens; Field evaluation of chemicals, antibiotics, bio-agents against plant pathogens- Soil solarisation, methods of soil fumigation under protected cultivation.

Unit V

ED and MIC values, study of structural details of sprayers and dusters- Artificial epiphytotic and screening of resistance. Role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures

Theory lecture schedule

1. Principles of plant disease management.
2. Exclusion of plant diseases
3. Quarantine and post-entry quarantine.
4. Eradication of plant pathogens.
5. Protection and cultural methods of plant disease management
6. Plant disease control – organic amendments
7. Integrated control measures of plant diseases
8. Immunization and disease resistance
9. Molecular approach for disease management
10. Molecular approach for disease management
11. History of fungicides.
12. History of bactericides and antibiotics
13. Concepts of pathogen
14. Immobilization and chemical protection.
15. Mid - Semester Examinations
16. Chemotherapy and nature.
17. Properties and mode of action of antifungal chemicals.
18. Properties and mode of action of antifungal chemicals.
19. Properties and mode of action of antibacterial chemicals
20. Properties and mode of action of antiviral chemicals
21. Label claim of fungicides
22. Methods of application of chemical fungicides, antibiotics and bio-agents
23. Methods of application of antibiotics and bio-agents
24. Phytopathometry

25. Methods of *in-vitro* evaluation of chemicals, antibiotics, bio agents against plant pathogens
26. Methods of *in-vitro* evaluation of chemicals, antibiotics, bio agents against plant pathogens
27. Field evaluation of chemicals fungicides against plant pathogens
28. Field evaluation of antibiotics and bio-agents against plant pathogens
29. Soil solarisation, methods of soil fumigation under protected cultivation
30. ED and MIC values and study of structural details of sprayers and dusters
31. Artificial epiphytotic and screening of resistance
32. Role of stickers, spreaders and other adjuvants
33. Health vis-a-vis environmental hazards
34. Residual effects and safety measures

Practical schedule

1. Study of Phytopathometry
2. Preparation of Bordeaux mixture and Bordeaux paste.
3. Soil application methods.
4. Foliar application, sprayer, duster and ULV sprayer.
5. Special methods of application of fungicides.
6. *In-vitro* evaluation of chemicals against plant pathogens
7. *In-vitro* evaluation of antibiotics against plant pathogens
8. *In-vitro* evaluation of fungal bio-agents against plant pathogens
9. *In-vitro* evaluation of bacterial bio-agents against plant pathogens
10. Mass multiplication of fungal antagonists
11. Mass multiplication of bacterial antagonists
12. Soil solarisation
13. Methods of application of biocontrol agents
14. Methods of soil fumigation under protected cultivation
15. ED and MIC values
16. Artificial epiphytotic and screening of resistance
17. Record Certification

Course outcome:

- CO 1:** Knowing the Principles of plant disease management
- CO 2:** Having an idea about disease resistance and molecular approach for plant disease management
- CO3:** Acquiring knowledge on the mode of action of fungicides, bactericides, antibiotics and its environmental hazards
- CO4:** Acquainted on the mode of action of fungicides and the procedure for Label claim of new generation fungicides
- CO5:** Trained on methods of application of chemicals; biocontrol agents and plant protection appliances

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	2	2	-	2
CO 2	2	1	2	2	1
CO 3	2	1	2	2	2
CO 4	2	2	2	2	2
CO 5	3	3	2	-	3

Suggested readings

1. Narayanasamy P.2011. Crop Disease Management: Principles and Practices. New India Publishing Agency
2. Daren Mueller, Kiersten Wise, Nicholas Dufault, Carl Bradley, and Martin Chilvers 2013. Fungicides for Field Crops. APS Press.
3. Oliver R., Hewitt H.G. 2014. Fungicides in Crop Protection, 2nd Edition. CABI Publications.
4. Dale Walters. 2014. Disease Control in Crops Biological and Environmentally-Friendly Approaches. Wiley Science.
5. Jean Michel Mérillon and Kishan Gopal Ramawat. 2012. Plant Defence: Biological Control. Springer

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4. <https://epubs.icar.gov.in/index.php/IPPJ/article/view/18570/8978>
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PAT 509 - EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES (1+0)

Learning objectives

- To understand the elements, structure and patterns of epidemics
- To study the genetics of epidemics and area under disease progress curve
- To know the epidemiological basis of disease management, survey, surveillance and vigilance
- To learn the forecasting system and modelling for disease prediction
- To get acquainted with the remote sensing techniques and image analysis for disease prediction

Unit I

Epidemic concepts, simple interest and compound interest disease, historical development. Elements of epidemics and their interaction. Structures and patterns of epidemics. Modelling, system approaches and expert systems in plant pathology.

Unit II

Genetics of epidemics. Models for development of plant disease epidemics. Common and natural logarithms, function fitting, area under disease progress curve and correction factors, inoculum dynamics.

Unit III

Population biology of pathogens, temporal and spatial variability in plant pathogens. Epidemiological basis of disease management. survey, surveillance and vigilance.

Unit IV

Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting, some early forecasting and procedures based on weather and inoculum potential, modelling disease growth and disease prediction.

Unit V

Remote sensing techniques and image analysis. Crop loss assessment. Salient features of important forecasting models.

Theory lecture schedule

1. Introduction and historical development on epidemiology
2. Concepts of epidemics, simple and compound interest disease
3. Elements of epidemics and their interactions
4. Structures and patterns of epidemics
5. Modelling, system approaches and expert systems in plant pathology
6. Genetics of epidemics
7. Models for development of plant disease epidemics
8. **Mid semester examination**
9. Common and natural logarithms and function fitting
10. Area under disease progress curve and correction factors, inoculum dynamics
11. Population biology of pathogens, temporal and spatial variability in plant pathogens
12. Epidemiological basis of disease management.
13. Survey, surveillance and vigilance. Principles and pre-requisites of forecasting
14. Systems and factors affecting various components
15. Early forecasting and procedures based on weather and inoculum potential, modelling disease growth and disease prediction.
16. Remote sensing techniques and image analysis
17. Crop loss assessment and salient features of important forecasting models

Course outcome:

- CO 1:** Having knowledge in history, elements, pattern and modelling of plant disease epidemic
- CO2:** Having knowledge in genetics of epidemics, logarithms, function fitting and area under disease progress in plant diseases epidemiology
- CO 3:** Having expertise in plant disease survey, surveillance and vigilance
- CO 4:** Having expertise in plant disease forecasting
- CO 5:** Acquainted with remote sensing techniques and image analysis. Crop loss assessment

CO - PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	3	1	-
CO2	1	-	3	1	-
CO3	3	-	2	2	1
CO4	2	-	3	3	1
CO5	2	-	3	3	1

Suggested reading

1. Bernard Kaye, Michael Cooke B. and Gareth Jones D. 2019. Epidemiology of Plant Diseases. Springer.
2. Subramanya Sastry K. and Thomas A. Zitter 2016. Plant Virus and Viroid Diseases in the Tropics: Volume 2: Epidemiology and Management. Springer.
3. Jürgen Kranz. 2003. Comparative Epidemiology of Plant Diseases Springer Publications.
4. Laurence VM, Gareth H and Frame Van den Bosch (Eds.). The Study of Plant Disease Epidemics. APS, St. Paul, Minnesota.
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PAT 510- ECOLOGY OF SOIL BORNE PATHOGENS (1+1)

Learning objectives

- To understand the concept of biological control and ecology of soil borne pathogens.
- To study the dynamics of biological control, population dynamics and evolution
- To learn the biological interactions, competition and mycoparasitism of bio inoculants.
- To know the compatibility of different bioagents. mass multiplication of fungal and bacterial biocontrol agents
- To be aware of the bioinoculant interactions with pathogen, plants and microbial community and ecofriendly methods of managing soil borne pathogens

Unit I

Concept of biological control and ecology of soil borne pathogens, definitions, importance, history of biological control, merits and demerits of biological control, principles of plant disease management with bioagents. Suppressive soils, conducive soil, rhizosphere, plant growth promoting rhizobacteria, fungistasis, soil fungistasis, mycorrhizae, soil invading fungi, root inhabiting fungi, competitive saprophytic ability, role of root exudates

Unit II

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi, bacteria, actinomycetes, etc. Dynamics of biological control, population dynamics and evolution. Types of bio control agents, concepts and potentialities for managing soil borne pathogens, conservation of biological control. Factors governing biological control, role of physical environment, agro ecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship.

Unit III

Types of biological interactions, competition, mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control. Relationship among soil microbes, recent advances in study of soil borne plant pathogens, population dynamics of pathogens in soil, effect of root exudates on root infection

Unit IV

Comparative approaches to biological control of plant pathogens by resident and introduced antagonists, management of soil-borne, seed borne and foliar diseases. Compatibility of different bioagents. Important biological controls agents against various soil borne pathogens. Isolation, purification and mass multiplication of fungal and bacterial biocontrol agents, ideal character, delivery systems and quality parameters. List of commercially available biological control agents in plant disease management.

Unit V

Pre-immunization technique, hypovirulence. Plant extracts, essential oils, antiviral principles. Mycoherbicides, entomophagus fungus. Biocontrol agent interactions with pathogen, plants and microbial community, genetical aspects of pathogenic and saprophytic behavior in root-infecting fungi, effects of soil moisture and aeration on fungal activity with root diseases, methods of managing soil borne pathogens

Theory lecture schedule

1. Introduction to ecology of soil borne pathogens, Biocontrol: concept and definitions.
2. History of biological control, merits and demerits of biological control, principles of plant disease management with bioagents
3. Suppressive soils, conducive soil, rhizosphere, plant growth promoting rhizobacteria, fungistasis, soil fungistasis, mycorrhizae, soil invading fungi, root inhabiting fungi, competitive saprophytic ability, role of root exudates
4. nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi, bacteria, actinomycetes
5. Types of bio control agents, concepts and potentialities for managing soil borne pathogens, conservation of biological control
6. Dynamics of biological control, population dynamics and evolution, factors governing biological control
7. Biological control of soil-borne diseases and foliar diseases and mechanisms
- 8. Midsemester Examination**
9. Comparative approaches to biological control of plant pathogens by resident and introduced antagonists.
10. Types of biological interactions
11. Relationship among soil microbes, population dynamics of pathogens in soil
12. Compatibility of different bioagents. Important biological controls agents against various soil borne pathogens
13. Isolation, purification and mass multiplication of fungal and bacterial biocontrol agents
14. List of commercially available biological control agents in plant disease management
15. Pre-immunization technique, hypovirulence, Plant extracts, essential oils, antiviral principles
16. Genetical aspects of pathogenic and saprophytic behavior in root-infecting fungi, methods of managing soil borne pathogens
17. Role of plant extracts in plant disease management. Mycoherbicides and entomophagus fungus.

Practical schedule

1. Introduction to ecology of soil borne pathogens and biological control of plant diseases

2. Isolation of fungal and bacterial biocontrol agents (*Trichoderma*, *Pseudomonas* and *Bacillus* etc.)
3. Isolation of VAM
4. Testing the antagonistic activity of biocontrol agents against various soil borne plant pathogens (*Pythium*, *Fusarium*, *Rhizoctonia*, *Sclerotium*, *Macrophomina* etc.)
5. Testing the compatibility with other soil microflora
6. Methods of application of biocontrol agents
7. Antibiotic production of biocontrol agents
8. Fermentation technology and formulation development
9. Methods of mass multiplication of fungal and bacterial biocontrol agents
10. Quality control of bioagents
11. Ideal characters of biological control agents
12. Methods of quality control tests
13. Packing and storage of biocontrol formulations
14. Cross protection technique
15. Preparation and application of plant extracts in plant disease management
16. Antiviral principles
17. Visiting nearby biocontrol farm

Course outcome:

CO1: The students will have knowledge on ecology of soil borne diseases.

CO2: Acquainted with testing the compatibility of bioinoculants with other soil microflora and methods of application of biocontrol agents

CO3: Expertise in pre-immunization, AVP and hypo virulence.

CO4: Having expertise in mass multiplication of fungal and bacterial biocontrol agents

CO5: Acquainted with the use of plants extract and essential oils and knowing the methodology for culturing VAM.

CO PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	-	-
CO2	2	2	1	-	-
CO3	2	3	1	-	2
CO4	1	3	1	3	-
CO5	1	3	1	1	-

Suggested readings

1. Abraham Gamliel and Jaacov Katan. 2012. Soil Solarization: Theory and Practice. APS Press.
2. Narayanasamy P. 2019. Soilborne Microbial Plant Pathogens and Disease Management Volume One: Nature and Biology. CRC Press.
3. Narayanasamy P. 2019. Soilborne Microbial Plant Pathogens and Disease Management Volume Two: Management of crop diseases. CRC Press.
4. Tsuneo Watanabe. 2018. Pictorial Atlas of Soilborne Fungal Plant Pathogens and Diseases. CRC Press.
5. Samuel S. Gnanamanickam. 2002. Biological Control of Crop Diseases. CRC Press.

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3. <https://www.frontiersin.org/articles/10.3389/fmicb.2019.01030/pdf>
4. <https://ejbpc.springeropen.com/track/pdf/10.1186/s41938-020-00333-x.pdf>
5. <https://microbialcellfactories.biomedcentral.com/track/pdf/10.1186/s12934-020-01436-8.pdf>

PAT 511 INTEGRATED DISEASE MANAGEMENT (2+1)

Learning objectives

1. To study about the concept and tools of disease management.
2. To know the components of integrated disease management
3. To acquaint with the development of Integrated Disease Management
4. To learn about IDM of important crops viz., rice, wheat, pearl millet, cotton, sugarcane, chickpea, pulses, rapeseed and Mustard
5. To learn about IDM of important crops viz., vegetable crops, fruit crops, plantation and spice crops.

Unit I

Introduction, definition, concept and tools of disease management

Unit II

Components of integrated disease management- their limitations and implications.

Unit III

Development of IDM-basic principles, biological, chemical and cultural disease management.

Unit IV

IDM in important crops - rice, wheat, pearl millet, cotton, sugarcane, chickpea, pulses, rapeseed and Mustard

Unit V

IDM in important crops - Vegetable crops, fruit crops, plantation and spice crops.

Theory lecture schedule

1. Introduction of Plant disease management
2. Definition, concept and tools of Plant disease management
3. Components of integrated disease management
4. Integrated disease management - their limitations and implications
5. Development of Integrated disease management
6. Basic principles of Integrated disease management
7. Cultural methods of plant disease management
8. Chemical methods of plant disease management
9. Biological methods of plant disease management
10. IDM for Rice and Wheat
11. IDM for Pearl millet
12. IDM for Cotton
13. IDM for Sugarcane
14. IDM for Pulses - Black gram, green gram
15. IDM for cowpea and chickpea
16. IDM for Rapeseed and mustard

17. Mid-semester Examination

18. IDM for Vegetable crops - Tomato, brinjal and bhendi
19. Cucurbits and crucifers
20. Potato and sweet Potato
21. Beet Root and radish
22. Cassava, yam and taro
23. Chillies, onion and garlic
24. IDM for Fruit crops - Mango and banana
25. Citrus, guava, sapota and grapes
26. Pomegranate, custard apple, papaya, jack, pineapple, ber and aonla
27. Pear, peach and plum
28. IDM for Plantation crops
29. Tea and Coffee
30. Coconut and arecanut
31. Cocoa, rubber, and vanilla
32. IDM for Spice crops - Turmeric and ginger
33. Cardamom, pepper, betel vine, fenugreek
34. Coriander, clove, nutmeg and cinnamon

Practical

Application of physical, biological and cultural methods - Use of chemical and biocontrol agents, their compatibility and integration in IDM. Demonstration of IDM and multiple disease management in crops of regional importance as project work.

Practical lecture schedule

1. Application of physical methods - Soil solarization
2. Hot water treatment
3. Hot air treatment
4. Steam sterilization and Hot air sterilization

5. Exclusion
6. Avoidance
7. Eradication
8. Protection-Fungicides
9. Protection-Biologically based
10. Protection-Resistance
11. Protection-Resistance (r)
12. Therapy
13. Study on the compatibility of biocontrol and bio-fertilizers.
14. Study on the compatibility of biocontrol agents with fungicides.
15. Use of chemical and biocontrol agents, their compatibility and integration in IDM.
16. Demonstration of IDM and multiple disease management in crops of regional importance as project work.
17. Record Certification

Course outcome:

CO1: Having updated knowledge of the concept and tools of disease management.

CO2: Being aware of the Components of Integrated Disease Management

CO3: Having knowledge in development of Integrated Disease Management

CO4: Having updated knowledge about the IDM for important crops viz., rice, wheat, pearl millet, cotton, sugarcane, chickpea, pulses, rapeseed and Mustard

CO5: Having updated knowledge about the IDM for vegetable crops, fruit crops, plantation and spice crops.

CO-PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	-	-	2
CO2	1	1	-	1	-
CO3	2	1	2	-	2
CO4	2	1	3	3	2
CO5	2	1	1	2	2

Suggested readings

1. Ciancio A. and Mukerji K.G. 2007. General Concepts in Integrated Pest and Disease Management. Springer
2. Ciancio A. and Mukerji K.G. 2008. Integrated Management of Diseases Caused by Fungi, Phytoplasma and Bacteria. Springer
3. Imran Ul Haq and Siddra Ijaz. 2020. Plant Disease Management Strategies for Sustainable Agriculture through Traditional and Modern Approaches. Springer
4. Awasthi L.P. 2015. Recent Advances in the Diagnosis and Management of Plant Diseases. Springer
5. Pradeep kumar, Gupta V.K., Tiwari A.K. and Madhu Kamle. 2016. Current trends in Plant disease diagnostics and management practices. Springer

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PAT 512- DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS (2+1)

Learning objectives

- To acquire knowledge on etiology, symptoms, epidemiology and management practices of important diseases of major fruit crops
- To acquire knowledge on etiology, symptoms, epidemiology and management practices of important diseases of minor fruit crops
- To acquire knowledge on etiology, symptoms, epidemiology and management practices of important diseases of stone fruit and pome fruits crops
- To acquire knowledge on etiology, symptoms, epidemiology and management practices of important diseases of plantation crops.
- To know about the different environmental factors which influences the disease development in ornamental crops and their management

Unit I

Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like banana, pineapple, papaya, fig, pomegranate, date palm, Jack, custard apple and their management.

Unit II

Factors affecting disease development in fruits like mango, grapes, citrus, sapota, guava, ber and their management.

Unit III

Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, almond, strawberry and their management.

Unit IV

Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber, arecanut and coconut and their management.

Unit V

Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, jasmine, gladiolus, tulip, carnation, gerbera orchids, marigold, chrysanthemum and their management.

Theory lecture schedule

Etiology, symptoms, mode of spread, survival, epidemiology and management of diseases of the following crops.

1. Banana
2. Pineapple
3. Papaya
4. Fig
5. Pomegranate
6. Date palm
7. Jack
8. Custard apple
9. Mango
10. Grapes
11. Citrus
12. Guava, sapota
13. Ber
14. Apple
15. Pear
16. Peach
17. Mid Semester Examination
18. Plum
19. Apricot and Cherry
20. Walnut and Almond
21. Strawberry
22. Coffee
23. Tea
24. Rubber
25. Arecanut
26. Coconut
27. Rose
28. gladiolus
29. Tulip
30. carnation
31. Gerbera
32. Orchids
33. Marigold
34. Chrysanthemum

Practical schedule

Study of diseases, symptoms, host parasite relationship and management practices of:

1. Banana
2. Pineapple and Papaya
3. Fig, Pomegranate, Datepalm and Custard apple
4. Mango
5. Grapes
6. Citrus, Guava and Ber
7. Apple, Pear, Peach and Plum
8. Apricot, Cherry, Walnut, Almond and Strawberry
9. Coffee
10. Tea
11. Rubber
12. Arecanut
13. Coconut
14. Rose, jasmine and gladiolus
15. Tulip and carnation
16. Gerbera and Orchids
17. Marigold and Crysanthemum

Assignment: Students should submit 50 well-preserved diseased specimens.

Course outcome:

CO 1: The students will have in depth knowledge on plant diseases and their symptoms.

CO 2: Having knowledge about important disease cycle of plant pathogens

CO 3: Having expertise in identification of plant diseases by visual observation

CO 4: Being updated with epidemiological factors influencing plant disease development

CO 5: Knowing proper management practices for plant diseases

CO – PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	1	3
CO2	1	1	1	5	3
CO3	3	3	3	4	3
CO4	2	2	3	3	3
CO5	3	4	3	2	3

Suggested readings

1. Misra A. K., Chowdappa P., Sharma P. and Khetarpal R. K. 2013. Diseases of fruit crops. Indian Phytopathological Society.
2. Devappa V., Dinesh Singh and Jahagirdar S. 2017. Diseases of Ornamental Crops. Indian Phytopathological Society/ Today's and Tomorrow Publishers.
3. Chowdappa P., Pratibha Sharma, Anandaraj M. and Khetarpal R.K. 2014. Diseases of Plantation Crops. Indian Phytopathological Society/ Today's and Tomorrow Publishers.
4. Singh R.S. 2017. Diseases of Fruit Crops. Second Edition. Medtech Publishers
5. Ploetz R C. 2003. Diseases of Tropical Fruit Crops. CABI Publishing.

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4. <https://www.ijert.org/research/a-review-of-apple-diseases-detection-and-classification-IJERTV8IS040278.pdf>
5. <https://www.frontiersin.org/articles/10.3389/fpls.2016.01521/pdf>

PAT 513 DISEASES OF VEGETABLE AND SPICES CROPS (2+1)

Learning objectives

- To acquire knowledge on symptoms, etiology, disease cycle and management practices of important diseases of tuber & bulb crops.
- To acquire knowledge on symptoms, etiology, disease cycle and management practices of important diseases of crucifers and leafy vegetable crops.
- To acquire knowledge on symptoms, etiology, disease cycle and management practices of important diseases of cucurbit crops.
- To acquire knowledge on symptoms, etiology, disease cycle and management practices of important diseases of solanaceous crops.
- To acquire knowledge on symptoms, etiology, disease cycle and management practices of important diseases of spice crops.

Unit I

Nature, prevalence, factors affecting, disease development of potato, sweet potato, Onion, Garlic, Elephant Foot Yam, White Yam, Colocasia and Cassava and their Management.

Unit II

Nature, prevalence, factors affecting, disease development of Cabbage, Cauliflower, Knol khol, Brussel Sprout, Radish, Mustard, Beet root, Turnip, Cucumber, Watermelon, Muskmelon, Pumpkin, Gourds, Squash and their Management.

Unit III

Nature, prevalence, factors affecting, disease development of Lettuce, Broccoli, Spinach, Amaranthus, Brinjal, Tomato, Bhendi, Peas, Beans, Carrot and post-harvest diseases of vegetables vegetable crops and their management under natural and protected cultivation.

Unit IV

Nature, prevalence, factors affecting, disease development of spices such as Chilli, black pepper, cardamum, clove, nutmeg, cumin, coriander and their Management.

Unit V

Symptoms, epidemiology and management of diseases of different spice crops such as turmeric, Fennel, Fenugreek, Tamarind, saffron and ginger. Biotechnological approaches in developing disease resistant transgenics.

Theory lecture schedule

Etiology, symptoms, mode of spread, survival, epidemiology and management of diseases of the following crops.

1. Potato
2. Sweet Potato
3. Onion and garlic
4. Elephant foot yam and white yam
5. Colocasia and Cassava
6. Cabbage and Cauliflower
7. Knol Khol, Brusel Sprout and Radish
8. Mustard and Beet root
9. Turnip and Cucumber
10. Watermelon and Muskmelon
11. Pumpkin, Gourds and Squash
12. Lettuce and Broccoli
13. Spinach and Amaranthus
14. Brinjal
15. Tomato
16. Bhendi
17. Mid semester examination
18. Peas Beans and Carrot
19. Post-harvest diseases of vegetable crops and their management
20. Post-harvest diseases of vegetable crops and their management
21. Chilli
22. Cardamum
23. Black pepper

24. Nutmeg and clove
25. Cumin
26. Coriander
27. Fennel
28. Fenugreek
29. Tamarind
30. Turmeric
31. Saffron
32. Ginger
33. Biotechnological approaches in developing disease resistant transgenics.
34. Biotechnological approaches in developing disease resistant transgenics.

Practical schedule

1. Study of diseases symptoms and host parasite relationship of:
2. Potato and Sweet potato
3. Onion, garlic, elephant foot yam and white yam
4. Colocasia, cassava, cabbage and cauliflower
5. Knol khol, bruel sprout, Radish, mustard and beet root
6. Turnip, cucumber, watermelon and muskmelon
7. Pumpkin, gourds, squash,
8. Lettuce, Broccoli, spinach and Amaranthus
9. Brinjal and Tomato
10. Bhendi, peas, beans and carrot
11. Post-harvest diseases of vegetable crops and their management
12. Chilli
13. Black pepper, cardamum and nutmeg
14. Clove, Cumin and Coriander
15. Fennel, Fenugreek and Tamarind
16. Turmeric, Saffron and Ginger
17. Biotechnological approaches in developing disease resistant transgenics

Assignment: Students should submit 50 well-preserved diseased specimens.

Course outcome:

- CO 1:** To learn about new emerging diseases of vegetables, tuber and Spice crops
- CO 2:** Having in depth knowledge on various epidemiological factors influencing diseases
- CO 3:** Having expertise in identifying and managing diseases in tuber, bulb crops and in cruciferous crops
- CO 4:** Having expertise in identifying and managing diseases in cucurbits and solanaceous crops
- CO 5:** Having expertise in identifying and managing diseases in spice crops

CO – PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	-	-	-
CO2	-	2	-	-	-
CO3	3	-	-	-	-
CO4	-	3	3	-	-
CO5	-	-	-	-	3

Suggested readings

1. Srivastava J. N. and Singh A. K. 2022. Diseases of Horticultural Crops: Diagnosis and Management: Volume 2: Vegetable Crops (Innovations in Horticultural Science). Apple Academic Press.
2. Dinesh Singh, Chowdappa P. and Pratibha Sharma. 2014. Diseases of Vegetable Crops. Indian Phytopathological Society / Today's and Tomorrow Publishers.
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4. <https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/vg15010-soilborne-disease-in-vegetable-crops-guide.pdf>
5. https://conservancy.umn.edu/bitstream/handle/11299/184023/mn_1000_b_153.pdf?sequence=1&isAllowed=y

PAT 514 PLANT QUARANTINE AND REGULATIONS (1+0)

Learning objectives

- To study the Rules and regulation of Plant Quarantine.
- To study the Organizational set up of Plant Quarantine in India.
- To know the environmental Acts, APEDA, aspects of biosafety and biosecurity
- To get acquainted with the diagnosis and other techniques to detect pest/ pathogen infestations.
- To get acquainted with good laboratory practices, to study the WTO Regulations and phytosanitary measures.

Unit I

Historical development in Plant Quarantine, Definitions of pest, and transgenics as per Govt. notification; Organizational set up of Plant Quarantine in India. Relative importance; Quarantine – domestic and international.

Unit II

Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/ diseases and their status. Acts related to registration of pesticides and transgenics. History of Quarantine legislations, Salient features of PQ Order 2003.

Unit III

Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents. Identification of pest/ disease free areas; contamination of food with Toxigens, microorganisms and their elimination.

Unit IV

Symptomatic diagnosis and other techniques to detect pest/ pathogen infestations. VHT and other safer techniques of disinfestation/ salvaging of infected material. WTO regulations; non-tariff barriers;

Unit V

Pest Risk Analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures. Visit to Plant Quarantine station and PEQ facilities.

Theory lecture schedule

1. Historical development in Plant Quarantine.
2. Definitions of pest, and transgenics as per Govt. notification.
3. Organizational set up of Plant Quarantine in India.
4. Relative importance; Quarantine – domestic and international.
5. Quarantine restrictions in the movement of agricultural produce, seeds and planting material.
6. Case histories of exotic pests/ diseases and their status.
7. Acts related to registration of pesticides and transgenics.
8. Mid-Semester examination
9. History of Quarantine legislations, Salient features of PQ Order 2003.
10. Environmental Acts, Industrial registration.
11. APEDA- Import and Export of bio-control agents, Identification of disease-free areas.
12. Contamination of food with toxigens, microorganisms and their elimination.
13. Symptomatic diagnosis and other techniques to detect pest/ pathogen infestations.
14. VHT and other safer techniques of salvaging of infected material. WTO regulations.

15. Non-Tariff barriers. Pest Risk Analysis, laboratory practices for pesticide laboratories.
16. Pesticide industry; Sanitary and Phytosanitary measures.
17. Visit to Plant Quarantine station and PEQ facilities.

Course outcome:

- CO1:** The students will have knowledge on Plant Quarantine and WTO regulations.
CO2: Being aware on Exotic pests and diseases and Phytosanitary certificates.
CO3: Expertise in symptomatic diagnosis of pest/ pathogen infestations.
CO4: Being updated with Acts related to Plant Quarantine regulations.
CO5: Knowing the import and export of bio-control agents and APEDA

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	-	-
CO2	2	3	1	-	-
CO3	2	3	1	-	-
CO4	1	2	1	3	2
CO5	1	2	1	1	-

Suggested readings

1. Muthaiyan M C. 2009. Principles and Practices of Plant Quarantine. Allied Publishers Private Limited
2. David Ebbels. 2003. Principles of Plant Health and Quarantine. CABI Publishing.
3. Christina Devorshak. 2012. Plant Pest Risk Analysis: Concepts and Application. CABI Publishing.
4. Thind T.S., Jain R.K., Pratibha Sharma, Paul Khurana S.M., Rashmi Aggarwal, Sharma R.K., Dinesh Singh, Dubey S.C. and Kumar A. 2011. Plant Pathology in India: Vision 2030. Indian Phytopathological Society.
5. Shukla A and Veda OP. 2007. Introduction to Plant Quarantine. Samayprakashan, New Delhi.

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1. <https://plantquarantineindia.nic.in/PQISPub/html/Seeds.htm>
2. <https://plantquarantineindia.nic.in/PQISPub/html/Laws.htm>
3. <https://www.ippc.int/en/>
4. https://assets.ippc.int/static/media/files/publication/en/2022/05/ISPM_List_En_2022-04-08.pdf
5. <http://www.fao.org/3/j5062e/j5062e.pdf>

PAT 515 DISEASE RESISTANCE IN PLANTS (2+0)

Learning objectives

The subject deals with the process of pathogen infection, disease resistance, disease tolerance, physiological races of the pathogen and hypersensitivity.

- To study the concepts of disease resistance and types of resistance
- To study the host pathogen interaction and signal transduction
- To study the Pathogenesis related proteins and PAMP Signaling
- To get acquainted with the molecular detection and molecular variability of plant pathogens
- To get acquainted with the genetical approaches for plant disease management

Unit – I

Introduction and historical development, dynamics of pathogenicity - process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminology, Role of Plant Immune Signals and Signaling Systems in Plant Pathogenesis. Salicylic Acid Signaling in Plant Innate Immunity, Jasmonate Signaling System and Ethylene Signaling System in Plant Innate Immunity

Unit – II

Disease escape, disease tolerance, disease resistance, types of resistance, identification of physiological races of pathogens. Genetic basis of disease resistance, types of resistance, identification of physiological races of pathogen, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.

Unit – III

Disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.

Host defence system, morphological and anatomical resistance, preformed chemicals in host defence. PAMP Signaling in plant innate immunity, G-Proteins as Molecular Switches in Signal Transduction, Reactive Oxygen Species and Cognate Redox Signaling System in Plant Innate Immunity, Phospholipids Signaling System in Plant Innate Immunity

Unit – IV

Phytoalexins, Phytoanticipins, Phytosystatin hypersensitivity and its mechanisms. Classification of PR Proteins, Genes Encoding PR Proteins, How Do Pathogens Overcome Fungitoxic PR Proteins of the Host ? Molecular detection of Virus and Viroid Pathogens in Plants. Assessment of Variability in Plant Viral and Viroid Pathogens

Unit – V

Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment. Genetic basis of relationships between pathogen and host. Strategies for gene deployment. Genetic Resistance of Crops to Diseases, Molecular Techniques and Molecular variability of plant pathogens. SWEET Genes for Disease Resistance in Plants. TAL Effectors, Transgenic Resistance to Crop Diseases.

Theory lecture schedule

1. Introduction and historical development, dynamics of pathogenicity
2. Process of infection, variability in plant pathogens
3. Gene centres as sources of resistance
4. Disease resistance terminology
5. Role of Plant Immune Signals
6. Signaling Systems in Plant Pathogenesis.
7. Salicylic Acid Signaling in Plant Innate Immunity
8. Jasmonate Signaling System
9. Ethylene Signaling System in Plant Innate Immunity
10. Disease escape, disease tolerance
11. Disease resistance, types of resistance
12. Identification of physiological races of pathogens.
13. Genetic basis of disease resistance, types of resistance
14. Identification of physiological races of pathogen
15. Disease progression in relation to resistance
16. Stabilizing selection pressure in plant pathogens.
17. Mid semester examinations
18. Disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.
19. Host defence system, morphological and anatomical resistance, preformed chemicals in host defence.
20. PAMP Signaling in plant innate immunity, G-Proteins as Molecular Switches in Signal Transduction
21. Reactive Oxygen Species and Cognate Redox Signaling System in Plant Innate Immunity, Phospholipids Signaling System in Plant Innate Immunity
22. Phytoalexins
23. Phytoanticipins,
24. Phytosystatin hypersensitivity and its mechanisms.
25. Classification of PR Proteins
26. Genes Encoding PR Proteins
27. How Do Pathogens Overcome Fungitoxic PR Proteins of the Host?
28. Molecular detection of Virus and Viroid Pathogens in Plants. Assessment of Variability in Plant Viral and Viroid Pathogens
29. Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes.
30. Strategies for gene deployment. Genetic Resistance of Crops to Diseases
31. Molecular Techniques and Molecular variability of plant pathogens.
32. SWEET Genes for Disease Resistance in Plants
33. TAL Effectors
34. Transgenic Resistance to Crop Diseases.

Course outcome:

- CO 1:** Having knowledge about the disease resistance, plant innate immunity, Salicylic acid and Jasmonic acid signaling pathway
- CO 2:** Having an information about identification of Physiological races of plant pathogens
- CO 3:** Being aware of the PAMP Signaling in plant innate immunity
- CO 4:** Having knowledge of the Phytoalexins, Phytoanticipins, Phytosystatin, PR Proteins
- CO 5:** Expertise in Molecular Techniques and Molecular variability of plant pathogens

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	1	-	2
CO 2	2	3	2	-	1
CO 3	3	3	1	-	2
CO 4	1	3	2	-	1
CO 5	1	3	1	-	2

Suggested readings

1. Vidhyasekaran P. 2016. Switching on Plant Innate Immunity Signaling Systems, Bioengineering and Molecular Manipulation of PAMP-PIMP-PRR Signaling Complex, Springer
2. Vidhyasekaran P. 2015. Plant Hormone Signaling Systems in Plant Innate Immunity, Springer
3. Vidhyasekaran P. 2014. PAMP Signals in Plant Innate Immunity, Signal Perception and Transduction, Springer
4. Vidhyasekaran P. 2008. Fungal Pathogenesis in Plants and Crops, Molecular Biology and Host Defense Mechanisms Second Edition, CRC Press
5. Narayanasamy P. 2011. Microbial Plant Pathogens-Detection and Disease Diagnosis, Vol – I, II & III. Springer

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3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6871351/pdf/f1000research-8-22166.pdf>
4. https://scholar.google.com/scholar_url?url=https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2018.0322&hl=en&sa=T&oi=ucasa&ct=ufr&ei=ooB4YsHoN4a4ygTVhLbACA&scisig=AAGBfm10TEcBgXzCcmIdJCz4hFKIqKZxpQ
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PAT 516- CHEMICALS AND BOTANICALS IN PLANT DISEASE MANAGEMENT

(2+1)

Learning objectives

- To acquaint with the concepts, principles and judicious use of chemicals in plant disease management
- To study the classification of chemicals
- To acquaint with the formulations & mode of action of chemicals and factor affecting fungicides
- To know about fungicide resistance in plant pathogens, chemotherapy and phytotoxicity of fungicides. Cost-benefit ratio,.
- To study the efficacy of different botanicals used and their mode of action against plant pathogen.

Unit I - History of chemicals and botanicals.

History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals.

Unit II - Classification of chemicals

Classification of chemicals used in plant disease control – Copper, sulphur, mercury, quinone, heterocyclic nitrogen compound, organo tin , benzene and miscellaneous , systemic fungicides and antibiotics , general characteristics, New generation chemicals/ fungicides , FRAC

Unit III - Botanicals

Chemicals in plant disease control, viz., fungicides, bactericides, nematocides, antiviral chemicals and botanicals. Formulations-solid and liquid, fungicides calculations, Role of stickers, adjuvants and spreaders

Unit IV - New generation fungicides and Formulations

Fungicides - mode of action and application of different fungicides, special methods of application , Fungicide resistance in plant pathogens, chemotherapy and phytotoxicity of fungicides. Toxicity levels of fungicides

Unit V - Handling of fungicides and fungicidal resistance.

Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. Good laboratory practices for agrochemical laboratories General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

Theory lecture schedule

1. History and development of chemicals
2. Definition of pesticides and related terms
3. Advantages and disadvantages of chemicals.
4. Classification of fungicides
5. Copper fungicides
6. Sulphur fungicides
7. Mercury, quinone,
8. Heterocyclic nitrogen compound and organo tin compounds
9. Benzene and miscellaneous

10. Systemic fungicides
11. Systemic fungicides, mode of action, advantages and disadvantages
12. Antibiotics
13. General characteristics of fungicides
14. New generation chemicals/ fungicides ,
15. FRAC code
16. Chemicals in plant disease control viz., bactericides, nematicides.
17. Mid semester examination
18. Antiviral chemicals
19. Botanicals
20. Formulations-solid
21. Formulations-Liquid
22. Fungicides calculations
23. Role of stickers, adjuvants and spreaders
24. Mode of action of different fungicides
25. Application of different fungicides
26. Special methods of application
27. Fungicide resistance in plant pathogens
28. Chemotherapy and phytotoxicity of fungicides
29. Toxicity levels of fungicides
30. Handling, storage and precautions to be taken while using fungicides
31. Compatibility with other agrochemicals,
32. Persistence, cost-benefit ratio, factor affecting fungicides
33. General account of plant protection appliances
34. Fungicides - environmental pollution, residues and health hazards,

Practical schedule

1. Classification of fungicides
2. Copper fungicides and their examples
3. Sulphur fungicides
4. Systemic fungicides
5. Antibiotics
6. New generation chemicals/ fungicides
7. Chemicals in plant disease control, viz., bactericides, nematicides.
8. Antiviral chemicals
9. Botanicals
10. Formulations-solid
11. Formulations-Liquid
12. Fungicides calculations
13. Role of stickers, adjuvants and spreaders
14. Application of different fungicides
15. Special methods of application
16. Handling, storage and precautions to be taken while using fungicides
17. Record certification

Course outcome:

- CO 1:** Students are aware about the judicious use of chemicals in plant disease management
- CO 2:** Being updated with the recent classification of fungicides.
- CO 3:** Having Expertise in application of fungicides and preparation of botanical fungicide.
- CO 4:** Having knowledge about precautions to be taken while using fungicides
- CO 5:** Knowing the efficacy of different botanicals used and their mode of action against plant pathogen.

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	-	1
CO2	-	-	2	-	2
CO3	1	2	2	-	1
CO4	1	1	2	-	2
CO5	2	1	3	-	1

Suggested readings

1. Tarlochan S Thind. 2011. Fungicide Resistance in Crop Protection, Risk and Management. CABI Publications.
2. Arun Arya and Analiá Perelló. 2010. Management of Fungal Plant Pathogens. CABI Publications.
3. Mukesh K. Meghvansi and Ajit Varma. 2015. Organic Amendments and Soil Suppressiveness in Plant Disease Management. Springer
4. Vadivel K., Ganesan S. and Jayaraman J. 2015. Sustainable Crop Disease Management Using Natural Products. CABI Publications.
5. Maria R. Finckh, Ariena H. C. van Bruggen, and Lucius Tamm. 2015. Plant Diseases and Their Management in Organic Agriculture. APS Press.

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2. <https://www.frontiersin.org/articles/10.3389/fpls.2021.700507/pdf>
3. <https://www.sciencedirect.com/science/article/pii/S2095311915613004/pdf?md5=3ee547a062e5b856a01f1f13a94ba381&pid=1-s2.0-S2095311915613004-main.pdf>
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PAT 517 DETECTION AND MANAGEMENT OF SEED BORNE PATHOGENS (2+1)

Learning objectives

- To study the economic importance of seed pathology and role of plant quarantine in seed borne disease management.
- To study the recent advance and subsequent cause for disease development in seed and seedling
- To study the losses caused by seed borne diseases and their management practices.
- To know the effect of Epidemiological factors on transmission of seed-borne diseases
- To study the toxic metabolites affecting seed quality and its impact on human, animal and plant health and to study the detection methods for seed borne microorganism

Unit I

History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

Unit II

Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

Unit III

Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens.

Unit IV

Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

Unit V

Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogens/ diseases and procedure for healthy seed production. Seed health testing, methods for detecting microorganism.

Theory lecture schedule

1. History of seed pathology
2. Economic importance of seed pathology in seed industry
3. Importance of plant Quarantine in seed quality
4. SPS under WTO
5. Morphology of typical monocotyledon and dicotyledon

6. Recent advance in the establishment and subsequent cause of disease development seed
7. Recent advance in establishment and cause for disease development in seedling
Localization of seed transmission related to seed infection.
8. Mechanism of seed infection
9. Transmission of pathogen from seed to plant
10. Transmission of pathogen plant to seed
11. Seed certification, type of seed certification
12. Tolerance limit caused by seed borne disease
13. Type of losses caused by seed borne disease
14. Type of losses caused by Vegetatively propagated seed
15. Evolutionary adaptation of crop plant defined seed invasion by seed borne pathogen
16. Evolutionary adaptation of crop plant define seed true and vegetative propagated seed.

17. Mid semester examination

18. Epidemiological factors influencing the transmission of seed borne disease
19. Development epidemiological models for seed borne disease
20. Forecasting of epidemic through seed borne infection
21. Production of toxic metabolites affecting seed quality
22. Types of toxin that infects seed quality
23. Different form of toxin that makes impact on human
24. Different form of toxin impact on animal
25. Different form of toxin that impact on plant health
26. Management of seed borne pathogen physical management of seed borne pathogen.
27. Chemical management of seed borne pathogen
28. Biological management of seed borne pathogen
29. Physical management of seed borne pathogen
30. Seed health testing
31. Types of seed health testing
32. Methods for detecting micro-organism (fungi Bacteria, Virus)
33. Advance method for detecting seed borne micro-organism
34. Advance tool method for detecting micro-organism

Practical schedule

1. Conventional method of detection for fungal pathogen
2. Conventional method of detection for bacteria pathogen
3. Conventional method of detection for virus pathogen
4. Blotter paper technique
5. Roll towel method
6. Staining method to identify fungal pathogen
7. ELISA technique for virus detection

8. PCR technique in detecting fungal pathogen
9. Western blot method in detecting fungal pathogen
10. RT-PCR technique in detecting virus pathogen
11. Identification of various seed borne fungal pathogen and its expression in field
12. Identification of various seed borne viral pathogen and its expression in field
13. Identification of various seed borne bacterial diseases and vegetatively propagated material and its expression in the field
14. Estimation of toxins in seed developed by pathogens
15. Development of incubation plants maintain viral inoculum
16. Relationship between seed borne infection and expression of diseases
17. Record certification

Course outcome:

CO 1: Having knowledge of economic losses in crop plants by seed borne pathogens

CO 2: Having knowledge of plant quarantine measures for controlling the seed borne inoculum

CO 3: Having knowledge of economic importance of seed borne diseases and managing them

CO 4: Having knowledge of factors influencing the transmission of seed-borne diseases

CO 5: Having expertise in detection methods for seed borne microorganism

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	-	1
CO2	-	-	2	-	2
CO3	1	2	2	-	1
CO4	1	1	2	-	2
CO5	2	1	3	-	1

Suggested readings

1. Ashok Gaur. 2011. An introduction to Seed Pathology, Kalyani Publishers.
2. Agarwal VK and Sinclair JB. 1993. Principles of Seed Pathology. Vols. I & II, CBS Publ., New Delhi.
3. Subramanya Sastry K. 2013. Seed-borne plant virus diseases. Springer.
4. Ravindra Kumar and Anuja Gupta. 2020. Seed-Borne Diseases of Agricultural Crops: Detection, Diagnosis & Management. Springer.
5. Dalbir Singh and Mathur S. B. 2004. Histopathology of Seed-Borne Infections. CRC Press.

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4. <https://www.ijcmas.com/8-3-2019/Pooja%20Upadhyay%20and%20Samar%20Pal%20Singh.pdf>
5. <https://seednet.gov.in/PDFFILES/Chapter%209.pdf>

PAT 518 - BIOLOGICAL CONTROL OF PLANT PATHOGENS (1+1)

Learning objectives

- To study concepts of biological control and its significance.
- To study operational mechanisms and its relevance in biological control.
- To study factors governing biological control.
- To study about biological control of soil-borne and foliar diseases.
- To study about Commercial production of antagonists and their delivery systems.

Unit I

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control- Suppressive and conducive soils – General and specific suppression.

Unit II

Types of biological interactions, competition: mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control- Factors affecting biological agents – pathogens in relation to soil moisture, temperature, soil pH – influence of organic matter and fertility on soil borne pathogens and antagonists.

Unit III

Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens- Soil fungi stasis – influence of root exudates on establishment of pathogen and antagonists – influence of rhizosphere microflora on soil borne pathogens and antagonists - pathogens and antagonists and their relationship - comparative approaches to biological control of plant pathogens by resident and introduced antagonists.

Unit IV

Control of soil-borne and foliar diseases. Compatibility of bioagents with agrochemicals and other antagonistic microbes - Effect of agrochemicals and fertilizers on soil borne pathogens and antagonists- Mechanism of biocontrol – competition, antibiosis, lysis, hyper parasitism and induced systemic resistance – Biological control of soil borne pathogens with Actinobacteria, Yeast and AM fungi.

Unit V

Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system - Endophytes, Non endophytes - Biopesticides available in market. Quality control system of biocontrol agents.

Theory lecture schedule

1. Introduction to Biological control and Important milestones
2. Concepts of biological control and Ecology of soil borne pathogens
3. Suppressive and conducive soils
4. Merits and demerits of Biological control
5. Mycoparasitism, exploitation for hypovirulence, competitive saprophytic ability

6. Antibiosis and induced resistance
7. Factors affecting biological agents
8. Mid semester examination
9. Soil fungi stasis and Influence of root exudates on establishment of pathogen and antagonists
10. Comparative approaches to biological control of plant pathogens by resident and introduced antagonists
11. Compatibility of bioagents with agrochemicals and Effect of agrochemicals and fertilizers on soil borne pathogens and antagonists
12. Mechanism of biocontrol
13. Induced systemic resistance and SAR
14. Commercial production of antagonists
15. Delivery systems of antagonists
16. Endophytes and Non endophytes - Quality control system of biocontrol agents.
17. Biological control in IDM, IPM and organic farming system

Practical Schedule

1. Isolation of fungal biocontrol agents from Rhizosphere soil
2. Isolation of bacterial biocontrol agents from Rhizosphere soil
3. Purification of fungal biocontrol agent
4. Purification of bacterial biocontrol agents
5. Methods of testing in vitro antagonism
6. Assay of competitive saprophytic ability
7. Assay of Antibiotics production
8. Assay of Siderophores production
9. Assay of Lytic enzymes
10. Assay of β 1,3-glucanase
11. Assay of Cello bio hydrolase
12. Isolation of mychorriza and Establishing its biocontrol potentiality
13. Preparation of different formulations of selected bioagents
14. Mass production and Quality parameters of biocontrol agents
15. Application of antagonists against pathogen *in-vitro and in vivo* conditions
16. Compatibility of agrochemicals with bio inoculants
17. Record /Project submission

Course outcome:

CO 1: Having knowledge on the concepts of biological control and its significance.

CO 2: Gain knowledge on operational mechanisms and its relevance in biological control.

CO 3: Gain knowledge on factors governing biological control.

CO 4: Having knowledge on the biological control of soil-borne and foliar diseases.

CO 5: To get acquainted with the commercial production of antagonists and their delivery systems

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	1	1	-	2
CO 2	2	-	2	1	2
CO 3	2	-	3	1	2
CO 4	2	1	2	1	3
CO 5	1	-	1	1	3

Suggested readings

1. Campbell R. 1989. Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge.
2. Gnanamanickam SS (Eds). 2002. Biological Control of Crop Diseases. CRC Press,
3. Narayanasamy, P. 2015. Biological Management of Diseases of Crops. Vol.1. Characteristics of Biological Control Agents. Springer Science & Business Media, 2013.
4. Narayanasamy, P. 2015. Biological Management of Diseases of Crops. Vol.2. Integration of Biological Control Strategies with Crop Disease Management Systems. Springer Publications.
5. Pratibha Sharma 2014. Biological Control of Plant Diseases and Weeds. 2014. ICAR Publications. Delhi, India.

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PAT 519- POST-HARVEST DISEASES (1+1)

Learning objectives

- To learn the importance of post-harvest diseases.
- To know about the post-harvest diseases by biotic and abiotic factors.
- To know about the mechanisms and spread of diseases and their management.
- To know the role of biocontrol agents and chemicals in controlling post-harvest diseases.
- To get acquainted with the integrated approaches in controlling post-harvest diseases.

Unit I

Concept of post-harvest diseases, definitions, importance concerning management and health, principles of plant disease management as pre-harvest and post-harvest.

Unit II

Types of post-harvest problems both by biotic and abiotic factors.

Unit III

Role of the physical environment, agro-ecosystem leading to quiescent infection, operational mechanisms and cultural practices in the perpetuation of pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post-harvest diseases, comparative approaches to control of plant pathogens by resident and introduced antagonists.

Unit IV

Integrated approaches in controlling diseases and improving the shelf life of produce using nutritional, biocontrol agents and other agents, control of aflatoxigenic and mycotoxigenic fungi, application and monitoring for health hazards.

Unit V

Study of symptoms, toxicosis of various pathogens, and knowledge of Codex Alimentarius for each product and commodity. Physical and biological agents/ practices responsible for the development/ prevention of post-harvest diseases-traditional and improved practices.

Theory lecture schedule

1. Post-harvest diseases - concept and definitions
2. Post-harvest diseases important concerning management and health
3. Principles of plant disease management as pre-harvest and post-harvest diseases
4. Post-harvest problems by biotic and abiotic pathogens
5. Role of the physical environment, agro-ecosystem leading to quiescent infection
6. Operational mechanisms and cultural practices in the perpetuation of pathogens
7. Mid-semester examination
8. Pathogens and antagonist and their relationship
9. Role of biocontrol agents and chemicals in controlling post-harvest diseases
10. Comparative approaches to control of plant pathogens by residents and introduced antagonists
11. Integrated approaches to controlling diseases
12. Improving the shelf life of produce using nutritional, biocontrol agents, and other agents
13. Control of aflatoxigenic and mycotoxigenic fungi
14. Biocontrol agent application and monitoring for health hazards
15. Study of symptoms, toxicosis of pathogens
16. Knowledge of Codex Alimentarius for each product and commodity
17. Physical practices and biological agents responsible for the development/ prevention of post-harvest diseases-traditional and improved practices

Practical schedule

1. Isolation of post-harvest fungal pathogens
2. Isolation of post-harvest bacterial pathogens
3. Morphological characterization of fungal pathogens
4. Morphological characterization of bacterial pathogens
5. Molecular characterization of fungal pathogens
6. Molecular characterization of fungal pathogens
7. Molecular characterization of bacterial pathogens
8. Molecular characterization of bacterial pathogens
9. Maintenance of post-harvest pathogens
10. Isolation of biocontrol agents
11. Testing biocontrol agents against pathogens in vitro condition
12. Application of antagonists against pathogens in vivo condition
13. Comparative efficacy of different post-harvest fungicides and bioagents in vivo condition
14. Study of different post-harvest diseases on cereals, pulses
15. Study of different post-harvest disease on oilseed, and commercial crops
16. Study of different post-harvest disease on vegetables, fruits, and flowers
17. Visit cold storage

Course outcome:

At the end of the course, the students will have:

CO1: Having knowledge to develop and implement post-harvest disease strategies;

CO2: Have expertise to work in laboratories for isolation of microorganisms of interest;

CO3: Have knowledge about the post-harvest diseases by biotic and abiotic factors;

CO4: Having knowledge of biocontrol agents and chemicals in controlling post-harvest diseases.

CO5: Aware of integrated approaches in controlling post-harvest diseases.

CO-PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	-	-	-
CO2	1	-	-	2	-
CO3	1	-	-	3	-
CO4	1	-	3	3	-
CO5	1	-	2	-	-

Suggested readings

1. Fatima S, Javeed Z and Ade A. 2006. Post Harvest Rots of Fruits. Discovery Publishing House Pvt. Ltd., New Delhi.
2. Gajendra Jagtap and Utpal Dey. 2012. Post Harvest Diseases: Practical Manual. LAP Lambert Academic Publishing.
3. Lakshmi Naga Nandini M, Srinivasulu B, and Gopal K. 2021. Postharvest diseases and their management. Notion Press Media Pvt. Ltd., Chennai.
4. Snowdon AL. 1990. Colour Atlas of Post–Harvest Diseases and Disorders of Fruits and Vegetables Volume 1: General Introduction and Fruits. Manson Publishing Ltd, 302 p.
5. Snowdon AL. 1991. Colour Atlas of Post–Harvest Diseases and Disorders of Fruits and Vegetables Volume 2: Vegetables. Manson Publishing Ltd, 718 p.

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1. <https://doi.org/10.1016/B978-0-444-50584-2.X5000-X>
2. <https://doi.org/10.1201/9781003045502>
3. <https://doi.org/10.1007/978-94-017-9020-8>
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SUPPORTING COURSES

STA 501 Statistical Methods for Applied Sciences (2+1)

Objectives

To acquaint the students about the basics of statistics and design of experiments

Theory

Unit – I

Box – Plot, Descriptive Statistics, Exploratory data analysis, Theory of Probability, Random variable and Mathematical Expectations. Concept of Discrete and Continuous Probability Distributions: Binomial, Poisson, Normal Distributions and their applications.

Unit – II

Concept of Sampling distribution; Chi – Square, t and F distributions. Tests of Significance based on Normal, Chi – Square, t and F distributions.

Unit – III

Simple, Multiple and Partial Correlation Coefficient; Rank Correlation, Simple and Multiple Linear Regression, Test of Significance of Correlation of Coefficient and Regression Coefficient and Coefficient of Determination

Unit – IV

Need for Design of Experiments, Characteristics of a good design, Basic Principles of Design of Experiments, Completely Randomized Design, Randomized Block Design and Latin Square Design Layout and their analysis.

Unit – V

Concepts of Factorial experiments 2^n , 3^2 factorial experiments; Concepts of Confounding in factorial experiments – Confounding in 2^3 factorial experiments; partial and total confounding; Split – plot design and Strip – plot design.

Lecture schedule

1. Meaning of Box-Plot
2. Descriptive Statistics – Concepts
3. Exploratory data analysis
4. Theory of Probability
5. Random variable and Mathematical Expectation
6. Discrete probability distributions – binomial and poisson distribution
7. Continuous probability distributions – normal distribution and their application
8. Concept of sampling distribution – Standard Error
- 9. First Test**
10. t distribution , F and Chi square distribution
11. Tests of significance based on t, z, (mean and equality of means only). X^2 test for goodness of fit.
12. Definition of correlation, significance and types
13. Properties of correlation coefficient
14. Definition of regression – measuring and uses of regression analysis properties.
15. Differences between correlation and regression.
16. Regression co – efficient - simple, linear.
- 17. Mid- semester examination**
18. Multiple linear regression co - efficient – standard error of estimate
19. Test of significance of observed regression co -efficient and co - efficient of determination.
20. Characteristics of agricultural experiments: concepts – field studies.
21. Characteristics of agricultural experiments -pot-culture – quantitative and qualitative variables.
22. Sources of errors and estimate of errors
23. Design of Experiments– Basic principles
24. Completely Randomized Design
25. Randomized Block Design
26. Latin Square Design
27. Comparison of treatments – least significant difference method
28. Duncan’s Multiple Range Test (DMRT)
29. Concept of factorial experiments
30. 2^n , 3^2 Factorial experiments
31. Principle of confounding in factorial experiments
32. Confounding in 2^3 Factorial experiments
33. Split-pot design
34. strip – plot design

Practical schedule

1. Estimation of samples statistic viz., means, SD, SE and CV.

2. Fitting of distributions – binomial and poisson
3. Z-test, t-test and paired t-test
4. Comparison of two variances using F-test
5. Bartlett's test for homogeneity of variances
6. Chi-square test for test of goodness of fit and homogeneity of ratio test for independence of attributes
7. Computation of correlation co-efficient and it's significance
8. Fitting of simple linear regression and testing the significance of regression coefficient
9. Multiple linear regressions fitting and testing
10. Determination of optimum plot size using uniformity trial.
11. Analysis of CRD and RBD
12. Analysis of LSD and DMRT
13. 2² Factorial Experiment
14. 2³ Factorial Experiment
15. Complete confounding in 2³ Factorial Experiment
16. Analysis of Split-plot and Strip-plot design
17. Final practical Examination

Reference Books

1. Bhattacharyya, G.K. and R.A. Johnson. 1997. Statistical concepts and methods, John Wiley and Sons, New York.
2. Crozon, F.E. and D.J. Cowden . 1986. Applied General Statistics, Prentice Hall of India, New Delhi.
3. Gomez, K.A. and A.A. Gomez. 1984. Statistical procedure for Agricultural Research, John Wiley and Sons, New York.
4. Panse, V.G. and P.V. Sukhatme. 1961. Statistical methods for Agricultural Workers, ICAR, New Delhi.
5. Ramaswamy, R. 1995. A text book of Agricultural Statistics, Wiley Limited, New Delhi.

COM-501 Information Technology in Agriculture (2+1)

Learning objectives

- Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office.
- Give students an in-depth understanding of why computers are essential components in business, education and society.
- Provide hands-on use of Microsoft Office applications Word, Excel, Access and PowerPoint. Completion of the assignments will result in MS Office applications knowledge and skills.
- To get familiar with basics of the Internet Programming and different IT tools in Agriculture.

Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions.

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web Statistical Sciences: Computer Application.

(WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Programming fundamentals with C - Constants and Variables - Data Types - Arithmetic expressions - assignment statements - Logical expressions - Control flow - Arrays and Structures.

Unit IV

Hyper Text Markup Language (HTML), DHTML, web based application development. Static websites, dynamic websites. Client Side processing - scripting languages.

Unit V

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

Theory Lecture schedule

1. Introduction to Computers, Anatomy of Computers.
2. Memory concepts.
3. Booting sequence of operating system.
4. Operating systems.
5. DOS, Windows, Unix
6. Types of VIRUS.
7. MS Office word, Creating, Editing, Formatting a document and saving a document.
8. MS Excel Data Presentation, Data graph creation.
9. MS Power Point Presentation.
10. MS Access Concepts of Database, Creating Database.
11. Statistical analysis and mathematical expressions.
12. Database Concepts.
13. Database in Agriculture.
14. Internet - World Wide Web (WWW)
15. Programming Languages, Computer programming languages.
16. e-Agriculture concepts and applications.

17. Programming Fundamentals with C.
18. **Mid Semester Examination**
19. Constant and Variable.
20. Data Types.
21. Operators.
22. Arrays and Structures.
23. HTML-DHTML.
24. Web based applications development.
25. Client side processing.
26. Scripting Languages
27. ICT in Agriculture.
28. IT application.
29. Computer Control devices.
30. Agri input management.
31. Smartphone Apps in Agriculture.
32. Agriculture for farm advises.
33. Agri-input management.
34. Postharvest management.

PRACTICAL SCHEDULE

1. MSWORD- Creating, Editing and Presenting a Scientific Document
2. MS POWER POINT- creating, editing and presenting a scientific Document
3. MSEXCEL- Creating a spreadsheet, writing expressions, Entering formula expression through the formula tool bar and use of inbuilt statistical, mathematical functions
4. MSEXCEL- Creating graphs, analysis of scientific data- Data analysis t-test, Regression, ANOVA
5. MSACCESS: Creating Database, preparing queries and reports
6. MSACCESS: Demonstration of Agri-information system
7. C program to find addition and subtraction of two numbers
8. C Program to find whether the given input is palindrome or not
9. C program to find the given number is Armstrong or not
10. C program for finding Fibonacci series.
11. C Program to find Factorial of a given number.
12. C Program for calculating student grade using if-else and switch statement
13. Introduction to World Wide Web (WWW) and its components
14. HTML: Creation of website
15. HTML: Creation of Scientific Calculator
16. Internet: Presentation and management agricultural information through web
17. Practical Exam

COURSE OUTCOMES

At the end of the course students will be able to

- CO 1:** Describe the usage of computers and why computers in society.

- CO2: E-Agriculture concepts and applications
 CO 3: Learn categories of programs.
 CO 4: Web based application development
 CO 5: Information Technology applications and systems.

CO-PO MAPPING MATRIX

	PO 1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2
CO2	-	1	3	1	1
CO3	-	3	2	3	-
CO4	3	-	-	-	-
CO 5	-	3	2	-	1

REFERENCES

1. Satish Jain, M Geetha, Kratika,(2012) Computer Course Windows 7 With Ms Office 2010, Bpb Publications.
2. Anupama Jain and AvneetMehra(2012), Computer Fundamental MS Office: Including Internet & Web Technology 2010.
3. Programming in Ansi C Paperback – 8 May 2012, by E Balagurusamy (Author).
4. Cox V, Wermers L and Reding E.E. 2006. *HTML Illustrated Complete*. 3rd Ed. Course Technology.
5. Meera SN 2008 ICTs in agricultural extension: Tactical to practical.

COMMON COMPULSORY COURSES

PGS 501 - LIBRARY AND INFORMATION SERVICES (0+1)

Objective

- To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary -Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services - (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing - information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized - library services; Use of Internet including search engines and its resources; e-resources access methods.

Practical Schedule

1. Introduction to library and its services

2. Role of libraries in education, research and technology transfer;
3. Classification systems and organization of library
4. Sources of information- Primary Sources, Secondary Sources and Tertiary Sources
- 5. First test**
6. Intricacies of abstracting and indexing services
7. Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
8. Tracing - information from reference sources; Literature survey
- 9. Mid- Semester**
10. Citation techniques/Preparation of bibliography;
11. Use of CD-ROM Databases,
12. Online Public Access Catalogue and other computerized - library services
13. Online Public Access Catalogue and other computerized - library services
14. Use of Internet including search engines and its resources
15. Use of Internet including search engines and its resources
16. e-resources access methods.
17. Final practical examination

PGS 502 - TECHNICAL WRITING AND COMMUNICATION SKILLS (0+1)

Objective

- To equip the students with skills *Viz.*, writing of dissertations, research papers, etc. and to communicate and articulate in English

Practical

Grammar - Tenses, parts of speech, clauses, punctuation marks; Error analysis Common errors; Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers. Proof reading. Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Structure of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Practical schedule

1. Grammar (Tenses, parts of speech)
2. Grammar (clauses, punctuation marks)
3. Error analysis (Common errors); Concord; Collocation;
4. Phonetic symbols and transcription;
- 5. First test**
6. Accentual pattern: Weak forms in connected speech
7. Participation in group discussion, Facing an interview; presentation of scientific papers.

8. Technical Writing- Various forms of scientific writings- theses, technical papers
- 9. Mid -semester examination**
10. Technical Writing- reviews, manuals
11. Structure of thesis and research communications
12. Writing of abstracts, summaries, précis, citations etc
13. Commonly used abbreviations in the theses and research communications
14. Illustrations, photographs and drawings with suitable captions
15. Pagination, numbering of tables and illustration, numbers and dates in scientific write-ups
16. Editing and proof-reading, Writing of a review article.
17. Final practical examination

Suggested Readings

1. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
2. Mohan K. 2005. Speaking English Effectively. MacMillan India.
3. Richard WS. 1969. Technical Writing. Barnes & Noble.
4. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
5. Wren PC & Martin H. 2006. High School English Grammar and Composition. S.Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Objectives

The objective of the course is to create awareness about intellectual property rights in agriculture. The course deals with management of patents, trademark, geographical indications, copy rights, designs, plant variety protection and biodiversity protection. The students will be taught on the marketing and commercialization of intellectual properties.

Theory

Unit - I- World trade organization - introduction

World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR) - importance of intellectual property management - IPR and economic growth - IPR and bio diversity - major areas of concern in intellectual property management - technology transfer and commercialization - forms of different intellectual properties generated by agricultural research.

Unit - II- Patent document

Discovery *versus* invention - patentability of biological inventions - procedure for patent protection - preparatory work - record keeping, writing a patent document, filing the patent document - types of patent application - patent application under the Patent Cooperation Treaty (PCT).

Unit - III- Plant genetic resources

Plant genetic resources - importance and conservation - sui generic system - plant varieties protection and farmers' rights act - registration of extinct varieties registration and protection of new varieties / hybrids / essentially derived varieties - dispute prevention and settlement - farmers' rights.

Unit - IV- Trademark

Trademark - geographical indications of goods and commodities - copy rights designs - biodiversity protection.

Unit - V- Benefit sharing

Procedures for commercialization of technology - valuation, costs and pricing of technology - licensing and implementation of intellectual properties - procedures for commercialization - exclusive and non exclusive marketing rights - research exemption and benefit sharing.

Theory schedule

1. World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR)
2. Importance of intellectual property management - IPR and economic growth - IPR and bio diversity
3. Major areas of concern in Intellectual property management - technology transfer and commercialization
4. Forms of different intellectual properties generated by agricultural research

5. First test

6. Discovery versus invention patentability of biological inventions
7. Procedure for patent protection, Preparatory work - record keeping, writing a patent document, filing the patent document
8. Types of patent application - patent application under the Patent Cooperation Treaty (PCT)

9. Mid semester examination

10. Plant genetic resources - importance and conservation
11. Sui generic system - plant varieties protection and farmers' rights act registration of extant varieties
12. Registration and protection of new varieties / hybrids / essentially derived varieties - dispute prevention and settlement - farmers' rights
13. Trade mark - geographical indications of goods and commodities - copy rights – designs ,Biodiversity protection,
14. Procedures for commercialization of technology - valuation, costs and pricing of technology
15. Licensing and implementation of intellectual properties - procedures for commercialization
16. Exclusive and non exclusive marketing rights - research exemption and benefit sharing

17. Final practical examination

Reference books

1. Arun Goyal and Moor Mohamed, 2001. *WTO in the New Millennium*, Academy of Business Studies, New Delhi.

2. Bilek Debroy, 2004. *Intellectual Property Rights*, BR World of books, New Delhi.
3. Ganguli, P., 2001. *Intellectual Property Rights - Unleashing the Knowledge Economy*. Tata McGraw Hill, New Delhi.
4. Narayanan, R., 2006. *Patent Law*, Eastern Law House, New Delhi.
5. Ramappa, T., 2000. *Intellectual Property Rights under WTO - Tasks before India*, Wheeler Publishing, New Delhi.

PGS 504- BASIC CONCEPTS IN LABORATORY TECHNIQUES (0 + 1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Unit-I-Safety measures and common laboratory equipment's

Safety measures while in labs; Handling of chemical substances; use of burettes, pipettes, measuring cylinders, flasks, separator funnel, condensers and micropipettes. Washing, drying and sterilization of glassware; drying of solvents/ chemicals.

Unit-II - Preparation of standard solutions

Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; preparations of different Agro-chemical doses in field and pot applications; preparation of solutions of acids; Neutralization of acid and bases; preparation of buffers of different strengths and pH values.

Unit-III-Use and handling of laboratory equipment's

Use and handling of vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath and water bath.

Unit-IV - Microscopy and media preparation

Use and handling of microscope and laminar flow-preparation of media-differential, selective and enriched media. Methods of sterilization –physical methods-dry and moist heat, cold, filtration and radiation, chemical methods and disinfectants.

Unit-V - In-vitro culture techniques

Description of flowering plants in botanical terms in relation to taxonomy- seed viability test-pollen fertility test-tissue culture media-composition of media-media preparation –instant media-aseptic manipulation-procedure for in vitro culture of explants-leaf bit-stem bit-anthers-pollen –microspores-ovule and embryo.

Practical schedule

1. Safety measures in labs and handling of chemical substances.
2. Common laboratory equipment's. Calibration and cleanliness of volumetric glass wares.
3. Methods of expressing strength of solutions.
4. Preparation of primary standard solutions and buffer solutions.
5. **First test**
6. Preparation of standard solutions for nutrient analysis of soil, plant and water.
7. Preparation of different Agro-chemical doses for field experiments, Preparation of buffer solutions,

8. Handling of instruments-vacuum pumps, thermometers, and magnetic stirrer.

9. Mid semester Examination

10. Handling of instruments-ovens, sand bath and water bath.

11. Handling and uses of microscopes and laminar flow.

12. Sterilization by physical methods and Sterilization by chemical methods.

13. Preparation of different media for culturing the micro-organisms.

14. Description of flowering plants-seed viability test and pollen fertility test.

15. Aseptic manipulations and media.

16. In vitro culture of different explants.

17. Final practical examination

References

1. Furr, A.K.2000.Handbook of laboratory safety. CRC press.

2. Jackson, M.L. 1997. Soil Chemical Analysis. Prentice Hall of India pvt. Ltd., New Delhi.

3. Prescott.L.M, Harley, P and Klein, A. 2003. Microbiology, 5th Edition, McGraw Hill, USA.

4. Gupta, P.K. 1997.Elements of Biotechnology, Rastogi Publications. Meerut.

5. Singh, B.D. 2005.Biotechnology, Expanding Horizons, Kalyani Publications, New Delhi.

e-Reference

1. Analytical chemistry vol.1 (pdf) www.freebookcentre.net.

2. Micheal Zehfus Analytical chemistry www.freebookcentre.net.

3. Introduction to Instrumental Analytical Chemistry Roger Terrell www.freebookcentre.net.

4. Analytical Chemistry lecture notes sadhu malyadri www.freebookcentre.net.

5. Manfred Sietz and Andreas Sonnenberg. Short introduction into analytical chemistry www.freebookcentre.net.

PGS 505 - AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Unit I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

Unit II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

Unit III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Unit IV

Research prioritization and selection of research problem – Research planning - review of literature – setting of objectives and hypothesis – research design and techniques – data collection – analysis – formulation of tables – interpretation of results- Computer software in tabulation, presentation - Thesis writing – writing of research articles- projects and report writing – Formulation and preparation of research / scheme proposal – Impact factor and citation index - citation and references- Guidelines for oral / poster presentations – Internet in scientific research.

Unit V

Authorship and copy right – Plagiarism – Scientific misconduct – Falsification of research results, data fabrication – Peer review, informed consent attribution of authorship and adequacy of peer review publication process -Responsibility of society and self – Public interest in research, relevance to society and motivation - Conflict of interest, moral commitment – Social trends on research ethics, adequate codes of conduct to regulate research activity

Theory lecture schedule

1. History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment
2. National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC)
3. Partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.
4. Research ethics: research integrity, research safety in laboratories
5. **First test**
6. Welfare of animals used in research, computer ethics, standards and problems in research ethics.

7. Concept and connotations of rural development, rural development policies and strategies.
8. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations.
- 9. Mid semester examination**
10. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.
11. Research prioritization and selection of research problem – Research planning - review of literature – setting of objectives and hypothesis – research design and techniques
12. Data collection – analysis – formulation of tables – interpretation of results- Computer software in tabulation and presentation
13. Thesis writing – writing of research articles- projects and report writing – Formulation and preparation of research / scheme proposal
14. Impact factor and citation index - citation and references- Guidelines for oral / poster presentations – Internet in scientific research.
15. Authorship and copy right – Plagiarism – Scientific misconduct – Falsification of research results, data fabrication – Peer review, informed consent attribution of authorship and adequacy of peer review publication process
16. Responsibility of society and self – Public interest in research, relevance to society and motivation - Conflict of interest, moral commitment
17. Social trends on research ethics, adequate codes of conduct to regulate research activity

Reference

1. Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
4. Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

NON GRADIAL COMPULSORY COURSES

NGC 001* DISASTER MANAGEMENT (1+ 0)

Objectives

- To introduce students to the key concepts and practices of mitigation for natural disasters and calamities and to equip them for disaster preparedness to conduct thorough assessment of hazards, risks vulnerability and capacity building strategies.

Theory

Unit I – Natural disaster

Natural Disasters - meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves.

Unit II – Climate change

Climatic change - Global warming, sea level rise, ozone depletion, Manmade disasters - Nuclear disasters, chemical disasters, biological disasters.

Unit III – Man – made disaster

Building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, disaster management- efforts to mitigate natural disasters at national and global levels – India's key hazards, vulnerabilities and disaster response mechanisms in India.

Unit IV – Disaster warning, response and preparedness

Concept of disaster management, national disaster management framework; financial arrangements, role of NGOs, community-based organizations, and media central, state, district and local administration. Dissemination of disaster warning, response to natural disasters, national, state, district level, relief – food and nutrition – water – health – mental health services.

Unit V – Rehabilitation

Rehabilitation – food - clothing - utensils - fuel – shelter – relief camp – sanitation and hygiene. Resilient farming concepts – reclamation and revival of the agriculture system after natural disaster (Bio-shield). Preparedness – Emergency Operations Centres (EOCS).

Theory lecture schedule

1. Natural Disaster - meaning and nature of natural disasters, their types and effects.
2. Flood, drought, cyclone, earthquakes landslides, avalanches, volcanic eruptions, Heat and cold waves.
3. Climatic change- Global warming, sea level rise, ozone depletion
4. **First test**
5. Manmade disaster - Nuclear disasters, chemical disasters, biological disasters.
6. Building fire, coal fire, forest fire. oil fire.
7. Air pollution, water pollution, deforestation, industrial wastewater pollution.
8. Disaster management- efforts to mitigate natural disasters. India's key hazards, vulnerabilities and disaster response mechanism in India.
9. **Mid-Semester examination**
10. Concept of disaster management, national disaster management framework.

11. Financial arrangements, role of NGOs, community-based organizations and media.
12. Central, state, district and local administration.
13. Dissemination of disaster warning - response to natural disasters, national, state, district level.
14. Relief – food and nutrition – water – health – mental health services.
15. Rehabilitation – tolerant and resistant crops- resilient farming concepts – bioshields - livelihood options – insurance and compensation.
16. Disaster preparedness - clothing and utensils and fuel – shelter – relief camp – sanitation and hygiene.
17. Preparedness – Emergency Operations Centers (EOCS).

References

1. Gautam, D R. 2009. *Community based disaster risk reduction*. Mercy Corps, Lalitpur, Nepal.
2. Gupta, HK. 2003. *Disaster management*. Indian National Science Academy. Orient Blackswan.
3. Hodgkinson, PE and Stewart, M. 1991. *Coping with Catastrophe: A handbook of disaster management*. Routledge.
4. Ministry of Home Affairs. 2010. *Standard operating procedure for responding to natural disasters*, Ministry of Home Affairs – Disaster management Division, New Delhi.
5. Sharma,VK.2001. *Disaster management*. National Centre for Disaster Management, India.
6. Das, H.P. 2016. *Climate change and agriculture implications for global food security*. BS Publications, Hyderabad.
7. Kelkar, R.R. 2010. *Climate change -A Holistic view*. BS Publications, Hyderabad.

e resources

1. [http:// research.un.org/en/disaste](http://research.un.org/en/disaste)
2. <https://searchworks.stanford.edu/>
3. <http://guodes.litrary.illinois.edu>c.php>
4. <http:// libguides. auu.edu.au>c.php>
5. www.wcpt.org

NGC 512* CONSTITUTION OF INDIA (1+0)

Objectives

- To Understand the basic feature of Indian constitution
- To gain knowledge about basic rights and duties of Indian citizens
- To ponder over the form of Indian Political system
- To have broad understanding about the pivotal provision related with liberty, quality and fraternity

Theory

Unit I: Constitution of India and Basic features and Fundamental Principles

Meaning of the Constitution and Constitutionalism - Origin & Development of the Constitution of India - salient features of the Constitution of India.

Unit II: Fundamental Rights and Duties

Fundamental Rights - Fundamental Duties - The Directive Principles of state policy

Unit III- Union Government

Executive: President, Prime Minister and Council of Ministers. –Legislature, Parliament- Judiciary: Supreme Court

Unit IV: State Government and Local Government

Executive: Governor, Chief Minister and Council of Ministers -Legislature- High Courts - Local Governments

Unit V: Constitutional Commissions

Election Commission -UPSC- Finance Commission

Lecture schedule

1. Constitution of India – Definition, Basic features
2. Fundamental principles
3. Difference between constitution and constitutionalism
4. **First test**
5. Origin and development of constitution
6. Salient features of constitution of India
7. Fundamental rights and Fundamental duties
8. Direct principles of state policy
9. **Mid Semester Examination**
10. Union government - President, Prime Minister and Council of Ministers
11. Legislature, Parliament
12. Judiciary: Supreme Court
13. Executive: Governor
14. Chief Minister and Council of Ministers and Legislature
15. High Courts and Local Governments
16. Election Commission and UPSC
17. Finance Commission

References

1. The Constitution of India **2017** Kindle Edition- Government of India
2. Bahkshi P. M. 2015 The Constitution of India. Universal Law Publishing Co Ltd
3. Pylle M.V. 2018 An Introduction to The Constitution of India. Vikas Publishing
4. Bhansali S.R.2015. Textbook on The Constitution of India. Universal LexisNexis

ANNEXURE-1
PROFORMA FOR FORMATION OF RESEARCH ADVISORY COMMITTEE
(To be sent before the end of I Semester)

1. Name of the student :
2. Enrolment number: Reg. No. :
3. Degree :
4. Subject :
5. Advisory Committee :

S.No.	Advisory Committee	Name, Designation and Department	Signature
1.	Chairperson		
2.	Members		
	Additional Member		
	Reasons for additional Member		

Professor and Head

Additional members may be included only in the allied faculty related to thesis research with full justification at the time of sending proposals (Program of research).

ANNEXURE-II
PROFORMA FOR CHANGE IN THE RESEARCH ADVISORY COMMITTEE

1. Name of the student :
2. Enrolment number: Reg. No.
3. Subject :
4. Degree :
5. Proposed Change :

Advisory Committee	Name and designation	Signature
a. Existing member		
b. Proposed member		

6. Reasons for change

Chairperson

Signature of Professor and Head

ANNEXURE-III

PROFORMA FOR OUTLINE OF RESEARCH WORK (ORW)

(To be sent before the end of I Semester)

1. Name :
2. Enrolment number: Reg. No.
3. Degree :
4. Subject :
5. Date of Joining :
6. Title of the research project :
7. Objectives :
8. Duration :
9. Review of work done :
10. Broad outline of work/methodology :
11. Semester wise break up of work :

Signature of student

Approval of the advisory committee

Advisory committee	Name	Signature
Chairperson		
Members		
1.		
2.		

Professor and Head

ANNEXURE-IV

PROFORMA FOR CHANGE IN OUTLINE OF RESEARCH WORK (ORW)

1. Name :
2. Enrolment number: Reg. No
- 3 Degree :
- 4 Subject
- 5 Reasons for change :
- 6 Proposed change in the approved Program of research:
- 7 Number of credits completed so far Under the approved program:
- 8 a. Whether already earned credits are to be retained or to be deleted:
b. if retained, justification:

Signature of the student

Approval of the Advisory Committee

Advisory committee	Name	Signature
Chairperson		
Members		
Intra		
Inter		

Professor and Head

ANNEXURE-V
DEPARTMENT OF _____
PROFORMA FOR EVALUATION OF SEMINAR

1. Name of the candidate :
2. Register Number :
3. Degree programme :
4. Semester :
5. Topic of the seminar
and credit :
6. Distribution of marks

Distribution of marks	Max Marks				
i. Literature coverage	40				
ii. Presentation	30				
iii. Use of audio – visual aid	10				
iv. Interactive skills	20				
Total	100				
Name					
Designation		Chairperson	Intra Member	Inter Member	Average
Signature					

Grade point:

Head of the Department

ANNEXURE-VI
PROFORMA FOR REGISTRATION OF RESEARCH CREDITS

(To be given during first week of semester)

PART A: PROGRAM

Semester:

Year:

Date of registration:

1. Name of the student and
2. Enrolment number:/Reg. No.:
3. Total research credits completed so far:
4. Research credits registered during the semester:
5. Program of work for this semester (list out the
Items of research work to be undertaken during
the semester) :

Approval of advisory committee

Advisory committee	Name	Signature
Chairperson		
Members		
1. Intra		
2. Inter		

Professor and Head

Approval may be accorded within 10 days of registration

ANNEXURE-VII
PROFORMA FOR EVALUATION OF RESEARCH CREDITS
PART B EVALUATION
(Evaluation to be done before the closure of Semester)

Date of Commencement semester:

Date of closure of semester:

Date of evaluation:

1. Name of the student
2. Enrolment number: Reg. No.:
3. Total research credits completed so far:
4. Research credits registered during the semester:
5. Whether the research work has been carried out as per the approved program:
6. If there is deviation specify the reasons :
7. Performance of the candidate : **SATISFACTORY /NOT SATISFACTORY**

Approval of the advisory committee

Advisory committee	Name	Signature
Chairperson		
Members		
1.Intra		
2.Inter		

Professor and Head

ANNEXURE- VIII
ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF _____
PROFORMA FOR EVALUATION OF THESIS

1. Name of the examiner:
2. Postal Address:
3. Telephone/Mobile:
4. E-Mail:
5. Name of the candidate :
6. Title of the thesis:
7. Date of receipt of the thesis copy:
8. Date of dispatch of the detailed report and thesis by the examiner to the Controller of Examinations:
9. Examiner's recommendations choosing one of the following based on quality of thesis
Please give your specific recommendation (select any one decision from the list below) with your signature and enclose your detailed report in separate sheet(s).
 - a. I recommend that the thesis entitled -----
-----submitted by ----- be accepted for award of the Degree of MASTER OF SCIENCE (AGRICULTURE / HORTICULTURE / AGRI BUSINESS MANAGEMENT) of Annamalai University, Annamalainagar.

(OR)
 - b. I do not recommend the acceptance of the thesis entitled.

----- Submitted by -----
-----for award of the Degree of MASTER OF SCIENCE (AGRICULTURE / HORTICULTURE / AGRI BUSINESS MANAGEMENT) of Annamalai University, Annamalainagar. (Please specify reasons)

Date:

Signature with Office Seal:

Note- Please enclose a detailed report in duplicate duly signed by you giving the merits and demerits of the thesis on the choice of problem, review of literature, methods followed, results and discussion, etc.

PROFORMA FOR REPORT OF THE FINAL VIVA VOCE EXAMINATION

The meeting of the Examining Committee for Mr./Ms. -----M.Sc.(Ag.)
Student Reg.No. ----- Majoring in -----was held at -----
-a.m /p.m on -----

The following members were present:

1. ----- : Chairperson
2. ----- : Member
3. ----- : Member
4. ----- : External examiner

The committee took note of the report of the external examiner Dr. -----
recommending the thesis for acceptance.

The final viva voce examination for the candidate was conducted by the members of the
Advisory Committee and external examiner. The candidate has secured
satisfactory/unsatisfactory

The Committee recommends/ does not recommend unanimously the award of Degree of
M.Sc.(Ag.) to Mr./Ms.-----

1. Chairman
2. Member
3. Member
4. External examiner:

The original report from the External Examiner is attached herewith

Chairperson of the Advisory Committee


Professor and Head

**CERTIFICATE FOR HAVING CARRIED OUT THE SUGGESTIONS OF THE
EXTERNAL EXAMINER AND ADVISORY COMMITTEE**

Certified that Mr./ Ms. ----- Reg. No. -----has carried out all the corrections and suggestions as pointed out by the External examiner and the Advisory Committee. He / She has submitted **TWO** copies of his/ M.Sc.(Ag.)/(Hort.)/Agri Business Management thesis in hard bound cover and two soft copies in CD format, two copies each of the abstract of thesis and summary of the findings both in Tamil and English in CD format.

Chairperson

Professor and Head

ANNAMALAI  **UNIVERSITY**
DEPARTMENT OF _____
FACULTY OF AGRICULTURE

Date:

CERTIFICATE

This is to certify that the thesis entitled “-----” submitted in partial fulfillment of the requirements for the award of the degree of ----- to Annamalai University, Annamalainagar is a record of bonafide research work carried out by -----, under my guidance and supervision and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has been published / not been published in part or full in any scientific or popular journals or magazines.

Chairman

1. Chairman :
2. Member :
3. Member :
4. External examiner :