M.Sc. (Ag.)

(Horticulture)

There are three specializations are offered by department of horticulture in session 2022-24

- Vegetable Science
- Fruit Science
- Floriculture and landscaping

(Under Semester System as Per ICAR Recommended)

Syllabus

Academic Session- 2022-24

Jananayak Chandrashekhar University, Ballia
Uttar Pradesh

About the Department:

The department of Horticulture started in June 2021. Teaching and research in Horticulture was started in JNCU Ballia in the year 2021. This was superseded by two-year master programme in 2021. The department have two Assistant Professor (Guest Faculty). Department organised various programmes and guest lectures in a way to develop professional skills in the students. We are looking forward to organize many more programmes, workshops and lectures for enriching students' ability and enhancing department strengths to accommodate with new developments in society.

About the Programme:

MSc Horticulture is a 2-year full-time postgraduate course that includes a study of cultivation of plants, breeding, harvesting, storage and shortage of vegetables & plants. The MSc Horticulture course motivates students to understand organic lifestyle, health benefits and learning about the aesthetics of plants & vegetables. It also covers deep concepts such as eco-friendly or sustainable development operations and food production. The course is digitally enhanced by introducing fundamentals of genetics and functionality in the course.

Vision:

The department is committed to provide academic excellence and quality of education to the students.

Development of excellent human resources and innovative technological services to community.

Mission:

The university aims at reaching the remotest area of its jurisdiction in order to cater to the needs of those requiring its services and desiring participation in its programmes. The university is committed to playing a significant role in the socio-economic upliftment of the masses of the Uttar Pradesh.

Programme Objectives:

To provide relevant education to the students in horticulture and allied sciences.

To promote research and training on sustainable development of horticulture productivity,cost reduction in farming.

To encourage the youth on entepreneurship and rural development.

Program learning outcomes: Revamping of post graduate programme in whole of Horticultural Science throughout the country, Imparting quality education, Development of technical manpower to cater the need of government, corporate, quasi government and research organizations both in India and abroad in horticulture. Exposure to the faculty in the latest technical know-how, Vital step to sustain the Golden Revolution in India.

Teaching Learning Process:

Multiple pedagogic techniques are used in importing the knowledge both within and outside the classrooms. Listed below are some such techniques.

- Lectures
- Tutorials
- PowerPoint presentations
- Project work
- Documentary films on relevant topics
- Debates, discussion, quiz
- Talks/ workshop
- Interaction with expert
- Outstation field trips – surveys designs.
- Internships

Assessment Methods: besides the formal system of university exams held at the end of each semester will as mid - semester and class test that are held regularly, the students are also assessed on the basis of the following;

- Written assignment
- Presentations
- Participation in class discussion
- Agility to think critically and creatively to solve problems.
- Reflexive thinking.
- Participation in exitance and co-curriculum activities.
- Critical assessment of Articles book, etc.

Title:

The title of the programme shall be masters in Horticulture.

Affiliation:

The proposed programme shall be governed by the department of Horticulture, Jananayak Chandrashekhar University, Ballia, Uttar Pradesh.

Duration:

The total duration of the programme shall be of two years, spread over in four semesters.

Seats:

The total number of students to be admitted to the programme shall be 20. The programme will be conducted on regular basis.

Fee:

As per university law and guidelines

Minimum Eligibility for Admission:

As per University guidelines or a three -four-year bachelors degree or equivalent in any stream discipline awarded by a University or institute established as per law and recognized as equivalent by this university with minimum 45% marks for general and OBC category and 40% marks for SC/ST and person with disability categories or equivalent grade, shall constitute the minimum requirements for admission to the masters in sociology programme.

- Reservation of seats for various categories shall be as per the Uttar Pradesh state government rules and regulations.

Admission procedure:

Admission procedure will tale place according to the University norms (Jananayak Chandrashekhar University, Ballia) and guidelines in this regard.

Medium of instructions:

The medium of instructions will be English and Hindi.

Attendance:

As per university norms minimum 75% in theory papers and practical papers.

Structure of the programme:

The main purpose of the mas2ters in sociology programme is to develop and disseminate knowledge skills and values through classroom teaching, field visit and research are necessary for promoting, maintaining and improving the functioning of individuals, groups and communities. The masters in sociology programmeis comprised of –

Theory papers

practical

Research/dissertation

Preamble

(Vegetable Science)

Vegetables are important constituents of Indian diet and play an important role ensuring nutritional security. They are generally of short duration, high yielding, nutraceuiticallyrich, economically viable and generating substantial on-farm and off-farm employment.Vegetables have aprestine place in Indian agricultural economy. The country is being blessed with diverse agro-climatic conditions ranged from the tempearate to arid more than 60cultivatedand30lesserknownvegetablesarebeinggrown.

Thecountryhaswitnessedatremendousgrowthinvegetableproductionandproductivityasaresultofimprovedvarieties/F1hybrids/technologiesthroughsystematicresearchcoupledwiththeirlargescaleadoptionbythefarmersanddevelopmentalpoliciesofgovernmentcomparedtoarea(2.84mha),production(16.5mt)andproductivity(5.8t/ha)in1950–51therehadbeenphenomenalincreaseinarea(>3folds;10.1mha),production(>10folds;185mt)andproductivity(>3folds;18.0t/ha)during2017–18.Increasingpercapitaincome,healthconciousness,urbanisation,shiftingoffarmerstohighvaluevegetablesduetohigherincome,favourableincomeelasticityofdemandandannualgrowthrateofdomesticdemandforvegetablesarealsoimportantfactorsfuelingitsgrowthinthecountry.During2016–17,thetotalexportsincludingpotatoandonionaccountedfor` 5,922croressharing35%oftotalhorticulturalexports.Withthecurrentlevelofvegetableproductioninthecountry(171mt),population(1.3billion)andconsidering25%postharvestlossesand5%exportandprocessing,thepercapitaavailabilityofvegetableproductioninourcountryis250gasagainst300grecommendeddietaryallowance(RDA).Withprojectedpopulationof1.45billionby2030,Indiahastoproduce210mtofvegetables.Thetargeted production needs to be achieved through utilizing scientific technological and traditionalstrengthinasustainablemannerwithoutmuchincreasingareaundervegetables.

Looking in to the above scenario in vegetable production, there is a need to update the knowledge among the post-graduates of Vegetable Science. An effort is therefore made toencompasstheadvancesmadeinthevegetableproductionbyrevistingthepost-graduatecurriculumfordeliveringandassuringqualityeducation.Theproposedcurriculumaimstodevelop a competent human resource equipped with holistic and updated knowledge and skill in the field of Vegetable Science.

Thecoursecurriculumhasbeenrestructuredtocoverthecurrentrequirementofvegetable production and post harvest management to increase capabilities of students.

Inorder to accomplish the task, either new courses have been formulated or existing coursecontentsareupgradedtoincludelatestdevelopmentsinvegetablesproduction.

Inlinewithnationalpolicies,theexistingcoursecontentshavebeenupgradedandfive new courses, viz., Principles of vegetable breeding, Breeding for special traits in Vegetable crops, Biodiversity and conservation of Vegetable crops, Biotechnological approaches inVegetablecropsandAdvancedlaboratotorytechniquesforvegetablecropshavebeen added.A course on Vegetable Breeding has been divided into two courses one for self-pollinatedcropsandanotherforcrosspollinatedvegetablecrops.Newcomponents,viz., hydroponics,aeroponics, grafting technique and precision farming have been added in appropriate courses.The overall upgradation of course contents as well as addition of courses are in line with national policy priorities like doubling of farmer's income, more crop per drop, jaivik krishi,soilhealth,skilldevelopment,entrepreneurshipdevelopment,startupinitiatives, etc.

Course Title with Credit Load
M.Sc.(Hort.)(Vegetable Science)

Course Code	Course Title	Credit Hours
HOR501*	Production of Cool Season Vegetable Crops	2+1
HOR502	Protected Cultivation of Vegetable Crops	2+1
AGR503	Principles and practices of Organic farming	2+1
PGS504	Intellectual property and its management in agriculture	1+0
STAT505	Experimental design	2+1
HOR506*	Production of Warm Season Vegetable Crops	2+1
HOR507	Seed Production of Vegetable Crops	2+1
AGR 508	Principles and Practices of soil fertility and nutrient management	2+1
PGS509	Basic Concepts in Laboratory Techniques	1+1
MCA510	Information Technology In Agriculture	0+1
HOR511*	Growth and Development of Vegetable Crops	2+1
HOR512	Post Harvest Management of Vegetable Crops	2+1
AGR513	Principles and Practices of Water Management	2+1
PGS514	Technical writing and communication skills	1+0
PGS515	Agricultural research, research ethics and rural development programmes	1+0
HOR516*	Principles of Vegetable Breeding	2+1
PGS517	Library and Information Techniques	0+1
HOR 550	Seminar	0+1
HOR 560	Research Thesis	0+30
	Total Credits	71

*Compulsory among major courses

1st Semester						Evaluation Marks
Code No.	**Course Title**	**Credit Hours**	**Mid Term**	**End Term**	**Practical**	**Total**
HOR501	Production of cool season vegetable crops	2+1	25	50	25	100
HOR502	Protected cultivation of vegetable crops	2+1	25	50	25	100
AGR503	Principles and practices of organic farming	2+1	25	50	25	100
PGS504	Intellectual property and its management in agriculture	1+0	25	50	25	100
STAT505	Experimental designs	2+1	25	50	25	100
Total Credits		**13**	-			

2nd Semester						Evaluation Marks
Code No.	**Course Title**	**Credit Hours**	**Mid Term**	**End Term**	**Practical**	**Total**
HOR506	Production of warm season vegetable	2+1	25	50	25	100
HOR507	Seed production of vegetable crops	2+1	25	50	25	100
AGR508	Principles and Practices of soil fertility and nutrient management	2+1	25	50	25	100
PGS509	Information technology in agriculture	1+1	25	50	25	100
MCA510	Basic concepts in laboratory techniques	0+1	25	50	25	100
Total Credits		**12**	-			

3rd Semester						Evaluation Marks
Code No.	**Course Title**	**Credit Hours**	**Mid Term**	**End Term**	**Practical**	**Total**
HOR511	Growth and development of vegetable crops	2+1	25	50	25	100
HOR512	Post harvest management of vegetable crops	2+1	25	50	25	100
AGR513	Principles and Practices of Water Management	2+1	25	50	25	100
PGS514	Technical writing and communication skills	0+1	25	50	25	100
PGS515	Agricultural research, Research ethics and rural development programs	1+0	25	50	25	100
Total Credits		**11**	-			

4th Semester						Evaluation Marks
Code No.	**Course Title**	**Credit Hours**	**Mid Term**	**End Term**	**Practical**	**Total**
HOR516	Principles of vegetable breeding	2+1	25	50	25	100
PGS517	Library and information services	1+0	25	50	25	100
HOR550	Seminar	1				
HOR560	Thesis research	30				
Total Credits		**35**	-			
Total Semester Credit Hours		**71**				

M.Sc.(Hort.)(VegetableScience)
First Semester

- **CourseTitle :ProductionofCoolSeasonVegetableCrops**
- **CourseCode :HOR501**
- **CreditHours :(2+1)**
- **Need ofcourse?**

  Cool season vegetables are a major source of dietary fibres, minerals and vitamins.Some of these vegetables also contribute protein, fat and carbohydrate. Most of theleafyandrootvegetablesarerichinminerals,especiallyinmicro-elementssuchas copper, manganese and zinc. Vegetables differ in their temperature requirementforpropergrowthanddevelopment.Mostofthewintervegetablecrop sarecultivatedin cool season when the monthly mean temperature does not exceed 21°C. Even intemperate climate, these vegetables are cultivated in spring summer in hilly trackswherethedaytimetemperatureinsummerislessthan21°C.Thestudentsofv egetablesciencneedtohaveanunderstandingofproductiontechnologyofimport antcoolseasonvegetablecropsandtheirmanagement.

- **Objective of Course**

  Toimpartknowledgeandskillsonadvancementinproductiontechnologyofcools easonvegetablecrops

  Thecourseisconstructedgivenasunder:

No.	Block	Unit
•	Productionofcoolseasonvegetable Bulbandtubercropscrops	I IIColecrops • Rootcrops • Peasand beansVLeafyveg etables

- **Theory**

  Introduction, commercial and nutritional importance, origin and distribution, botanyandtaxonomy,area,production,productivityandconstraints,soilrequire

ments,climaticfactorsforyieldandquality,commercialvarieties/hybrids,seedrateandseed treatment, raising of nursery, sowing/ planting time and methods,hrydroponicsandaeroponics,precisionfarming,croppingsystem,nutritionalincludingmicronutrientsandirrigationrequirements,interculturaloperations,specialhorticulturalpractices,weedcontrol,mulching,roleofplantgrowthregulators,physiological disorders, maturity indices, harvesting, yield, post-harvest management(grading,packagingandmarketing),pestanddiseasemanagementandproductioneconomicsofcrops.

UnitI

Bulbandtubercrops—Onion,garlicandpotato.

Colecrops—Cabbage,cauliflower,kohlrabi,broccoli,Brusselssproutsandkale.

UnitIII

Rootcrops—Carrot,radish,turnipandbeetroot.

UnitIV

Peasandbeans—Gardenpeasandbroadbean.

UnitV

Leafyvegetables—Beetleaf,fenugreek,corianderandlettuce.

- **Practical**
  - Scientificraisingofnurseryandseedtreatment;
  - Sowingandtransplanting;
  - Description of commercial varieties and hybrids;
  - Demonstrationonmethodsofirrigation,fertilizersandmicronutrientsapplication;
  - Mulchingpractices,weedmanagement;
  - Useofplantgrowthsubstancesincoolseasonvegetablecrops;
  - Studyofnutritionalandphysiologicaldisorders;
  - Studiesonhydroponics,aeroponicsandothersoillessculture;
  - Identificationofimportantpestanddiseasesandtheircontrol;
  - Preparationofcroppingschemeforcommercialfarms;
  - Visittocommercialfarm,greenhouse/polyhouses;
  - Visittovegetablemarket;
  - Analysisofbenefittocostratio.
- **TeachingMethods/Activities**
  - Classroomlectures
  - Assignment(writtenandspeaking)
  - Studentpresentation

- Handsontrainingofdifferentprocedures
- Groupdiscussion

- **Learningoutcome**

  Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:
  - Appreciatethe scope andscenario of coolseason vegetable cropsin India
  - Acquireknowledgeabouttheproductiontechnologyandpost-harvesthandlingofcoolseasonvegetablecrops
  - CalculatetheeconomicsofvegetableproductioninIndia

- **SuggestedReading**

BoseTK,KabirJ,MaityTK,ParthasarathyVAandSomMG.2003.*Vegetablecrops*.Vols.I-III.Nayaudyog.

BoseTK, Som MG and Kabir J. (Eds.). 1993.*Vegetablecrops*. Naya prokash.

ChadhaKLandKallooG.(Eds.).1993-94.*AdvancesinhorticultureVols*.V-X.Malhotrapubl.house.

ChadhaKL.(Ed.).2002.*Handbookofhorticulture*.ICAR.

ChauhanDVS.(Ed.).1986.*VegetableproductioninIndia*.Ramprasadandsons.

FageriaMS,ChoudharyBRandDhakaRS.2000.*Vegetablecrops:productiontechnology*.Vol.
II.Kalyanipublishers.

GopalakrishananTR.2007.*Vegetablecrops*.NewIndiapubl.agency.

HazraPandBanerjeeMKandChattopadhyayA.2012.*Varietiesofvegetablecrops inIndia*,(Secondedition),Kalyanipublishers,Ludhiana,199p.

HazraP.2016.*VegetableScience*.2ndedn,Kalyani publishers,Ludhiana.

HazraP.2019.*Vegetableproductionandtechnology*.NewIndiapublishingagency,New Delhi.

HazraP,ChattopadhyayA,KarmakarKandDuttaS.2011.*Moderntechnologyforvegetableproduction*,NewIndiapublishingagency,NewDelhi,413p

RanaMK.2008.*OlericultureinIndia*.Kalyanipublishers,NewDelhi.

Rana MK. 2008.
Scientificcultivationofvegetables.Kalyanipublishers,NewDelhi.RanaM K.2014.*Technologyforvegetableproduction*.Kalyanipublishers,NewD elhi.

RubatzkyVEandYamaguchiM.(Eds.).1997.*Worldvegetables:principles,production andnutritivevalues*.ChapmanandHall.

SainiGS.2001.*Atextbookofoleriandfloriculture*.Amanpublishinghouse.

SalunkheDKandKadamSS.(Ed.).1998.Handbookofvegetablescienceandtechnology:production,composition,storageandprocessing.Marceldekker.
ShanmugaveluKG.1989.*Productiontechnologyofvegetablecrops*.OxfordandIBH.
SinghDK.2007.*Modernvegetablevarietiesandproductiontechnology*.Internationalbookdistributing Co.
SinghSP.(Ed.).1989.*Productiontechnologyofvegetablecrops*.Agril.comm.res.centre.Thamburaj S and Singh N. (Eds.), 2004. *Vegetables, tuber crops and spices*.
ICAR.ThompsonHCandKellyWC.(Eds.).1978.*Vegetablecrops*.TataMcGraw-Hill.

- **CourseTitle :ProtectedCultivationofVegetableCrop**
- **CourseCode :HOR502**
- **CreditHours :(2+1)**
- **Need ofcourse?**

India is the second largest producer of vegetable crops in the world. However, itsvegetableproductionismuchlessthantherequirement,ifabalanceddietisprovided to every individual. There are different ways and means to achieve thistarget.Protectedcultivation,whichisthemodificationofthenaturalenvironment toachieveoptimumplantgrowth.Isthemostintensiveformofcropproduction

with a yield per unit area up to ten times superior to that of a field crop. Duringwinter under north-east Indian conditions, it is difficult to grow tomato, capsicum,cucurbits,frenchbean,amaranth,etc.inopenfield.However,variousty pesofprotectedstructurehavebeendevelopedforgrowingsomehighvaluecropsb y providingprotectionfromtheexcessivecold.Productionofoff-seasonvegetable nurseries under protected structure has become a profitable business. The mainpurpose of raising nursery plants in protected structure is to get higher profit anddisease free seedlings in off-season to raise early crop in protected and open fieldcondition. The low cost polyhouse is economical for small and marginal farmers,who cannot afford huge cost of high-tech polyhouse. Besides supplying the localmarkets, the production of polyhouse vegetables is greatly valued for its exportpotentialandplaysanimportantroleintheforeigntradebalanceofseveralna

tionaleconomies. The students of vegetable science need to have an understanding ofprotectedcultivationofvegetablecrops.

- **Objective of Course**

  Toimpartlatestknowledgeaboutgrowingofvegetablecropsunderprotectedenvironmentalconditions

  Thecourseisconstructedgivenasunder:

No.	Block	Unit
•	Protectedcultivationofvegetable crops	I. Scope and importance II.Typesofprotectedstructure • Abioticfactors • Nurseryraising • Cultivationofcrops • Solutionstoproblems

- **Theory**

UnitI

Scope and importance- Concept, scope and importance of protected cultivation ofvegetablecrops;Principles,design,orientationofstructure,lowandhighcostpolyhouses/greenhousestructures.

UnitII

Typesofprotectedstructure-Classificationandtypesofprotectedstructures-greenhouse/polyhouses,plastic-nonplasticlowtunnels,plasticwalkintunnels,highrooftunnelswithventilation,insectproofnethouses,shednethouses,rainshelters,NVP,climatecontrolgreenhouses,hydroponicsandaeroponics;Soilandsoillessmediaforbedpreparation;Designandinstallationofdripirrigationandfertigationsystem.

UnitIII

Abioticfactors-
Effectofenvironmentalfactorsandmanipulationoftemperature,light,carbondioxide,humidity,etc.ongrowthandyieldofdifferentvegetables.

UnitIV

Nursery raising- High tech vegetable nursery raising in protected structures usingplugsandportrays,differentmediaforgrowingnurseryunderprotectedcultivation;Nurseryproblemsandmanagementtechnologiesincludingfertigation

Cultivationofcrops-
Regulationoffloweringandfruitinginvegetablecrops;Technology for raising

tomato, sweet pepper, cucumber and other vegetables inprotected structures, including varieties and hybrids, training, pruning and stakingingrowingvegetablesunderprotectedstructures.

Unit V

Solutionstoproblems-

Problemsofgrowingvegetablesinprotectedstructuresandtheir remedies, physiological disorders, insect and disease management in protectedstructures; Use of protected structures for seed production; Economics of greenhousecropproduction.

- **Practical**
  - Studyofvarioustypesofprotectedstructure;
  - Studyofdifferentmethodstocontroltemperature,carbondioxideandlight;
  - Studyofdifferenttypesofgrowingmedia,trainingandpruningsystemsingreen housecrops;
  - Studyoffertigationandnutrientmanagementunderprotectedstructures;
  - Studyofinsectpestsanddiseasesingreenhouseanditscontrol;
  - Useofprotectedstructuresinhybridseedproductionofvegetables;
  - Economicsofprotectedcultivation(Anyonecrop);
  - Visittoestablishedgreen/polyhouses/shadenethousesintheregion.
- **TeachingMethods/Activities**
  - ClassroomLectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontrainingofdifferentprocedures
  - Groupdiscussion
- **Learningoutcome**

  Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:
  - AppreciatethescopeandscenarioofprotectedcultivationofvegetablecropsinI ndia
  - Acquireknowledgeabouttheeffectofabioticfactorsongrowth,floweringandp roductionofvegetablecrops
  - Gainingknowledgeaboutthedesigningofvariouslowcostprotectedstructures
  - Adoptingtheraisingofvegetableseedlingsinlowcostprotectedstructuresasent repreneur
- **SuggestedReading**

ChadhaKLandKallooG.(Eds.).1993-94.*Advancesinhorticulture*.MalhotraPub.House.ChandraSandSomV.2000.*Cultivatingvegetablesingreenhouse*.Indianhorticulture45:17-18.

KallooGandSinghK.(Eds.).2000.*Emergingscenarioinvegetableresearchanddevelopment*.ResearchperiodicalsandBookpubl.house.
Parvatha RP. 2016. *Sustainable crop protection under protected cultivation*. E-Book Springer.Prasad S and Kumar U. 2005. *Greenhouse management for horticultural crops*. 2nd Ed.Agrobios.ReshHM.2012.*Hydroponicfoodproduction*.7thEdn.CRCPress.
SinghB.2005.*Protectedcultivationofvegetablecrops*.Kalyanipublishers,NewDelhi
Singh DK and Peter KV. 2014. *Protectedcultivationofhorticulturalcrops*(1stEdition) NewIndiapublishingagency,NewDelhi
SinghS,SinghBandSabirN.2014.*Advancesinprotectedcultivation*.NewIndiapublishingagency,NewDelhi.
TiwariGN.2003.*Greenhousetechnologyforcontrolledenvironment*.Narosapubl.house.

- **CourseTitle :PrinciplesandPracticesofOrganicFarming**
- **CourseCode :AGR503**
- **CreditHours :2+1**
- **Objectiveofthecourse**

  Tostudytheprinciplesandpracticesoforganicfarmingforsustainablecropproduction.
- **Theory**

UnitI

Organic farming - concept and definition, its relevance to India and global agricultureandfutureprospects;principlesoforganicagriculture;organicsandfarmingstandards;organicfarmingandsustainableagriculture;selectionandconversionof land, soil and water management - land use, conservation tillage; shelter zones,hedges,pasturemanagement,agro-forestry.

UnitII

Organic farming and water use efficiency; soil fertility, nutrient recycling, organicresidues, organic manures, composting, soil biota and decomposition of organicresidues, earthworms and vermicompost, green manures, bio-fertilizers and biogastechnology.

UnitIII

Farming systems, selection of crops andcrop rotations, multiple and relay croppingsystems,intercroppinginrelationtomaintenanceofsoilproductivity.

UnitIV

Controlofweeds,diseasesandinsectpestmanagement,biologicalagentsandpher omones,bio-pesticides.

UnitV

Socio-
economicimpacts;marketingandexportpotential:inspection,certification,labeli ngandaccreditationprocedures;organicfarmingandnationaleconomy.

- **Practical**
  - Methodofmakingcompostbyaerobicmethod
  - Methodofmakingcompostbyanaerobicmethod
  - Methodofmakingvermicompost
  - Identificationandnurseryraisingofimportantagro-forestrytressandtressforshelterbelts
  - Efficientuseofbiofertilizers,techniqueoftreatinglegumeseedswith*Rhizobium* cultures,useof*Azotobacter*,*Azospirillum*,andPSBculturesinfield
  - Visittoabiogasplant
  - Visittoanorganicfarm
  - Qualitystandards,inspection,certificationandlabelingandaccreditationproce duresforfarmproducefromorganicfarms
- **Teachingmethods/activities**

  ClassroomteachingwithAVaids,groupdiscussion,assignment.exposurevisit
- **Learningoutcome**

  Basicknowledgeonorganicfarmingforsustainableagricultureanddevelopme
- **SuggestedReading**
  - AnanthakrishnanTN.(Ed.).1992.*EmergingTrendsinBiologicalControlofPh ytophagousInsects*.Oxford&IBH.
  - GaurAC.1982.*AManualofRuralComposting*,FAO/UNDPRegionalProject Document,FAO.
  - JoshiM.2016.*NewVistasofOrganicFarming*.ScientificPublishers
  - LampinN. 1990. *Organic Farming*. PressBooks, lpswitch,UK.
  - PalaniappanSPandAnanduraiK.1999.*OrganicFarming–TheoryandPractice*.ScientificPubl.
  - RaoBVVenkata.1995.*SmallFarmerFocusedIntegratedRuralDevelopment:Socio-economic EnvironmentandLegalPerspective*:Publ.3,ParisaraprajnaParishtana,Bangalore.
  - ReddyMV.(Ed.).1995.*SoilOrganismsandLitterDecompositionintheTropic s*.Oxford&IBH.
  - SharmaA.2002.*HandBookofOrganicFarming*.Agrobios.
  - SinghSP.(Ed.).1994.*TechnologyforProductionofNaturalEnemies*.PDBC,Bangalor e.

- SubbaRaoNS.2002.*SoilMicrobiology*.Oxford&IBH.
- TrivediRN.1993.*ATextBookofEnvironmentalSciences*,AnmolPubl.
- Veeresh GK,Shivashankar Kand SuiglacharMA. 1997.*OrganicFarming andSustainableAgriculture*.AssociationforPromotionofOrganicFarming,Bangalore.
- WHO.1990.*PublicHealthImpactofPesticidesUsedinAgriculture*.WHO.
- WoolmerPLandSwiftMJ.1994.*TheBiologicalManagementofTropicalSoilFertility*.TSBF&Wiley.

CourseTitle :Intellectual property and management In agriculture
CourseCode :PGS504
CreditHours :1+0

Objective of Course

Themainobjectiveofthiscourseistoequipstudentsandstakeholderswithknowledge of Intellectual Property Rights (IPR) related protection systems, theirsignificance and use of IPR as a tool for wealth and value creation in a knowledge-basedeconomy.

Theory

HistoricalperspectivesandneedfortheintroductionofIntellectualPropertyRight regime;TRIPsandvariousprovisionsinTRIPSAgreement;IntellectualPropertyandIntellectualPropertyRights(IPR),benefitsofsecuringIPRs;IndianLegislationsfortheprotectionofvarioustypesofIntellectualProperties;Fundamentalsofpatents,copyrights,geographicalindications,designsandlayout,tradesecretsandtraditionalknowledge,trademarks,protectionofplantvarietiesandfarmers'rightsand biodiversity protection; Protectable subject matters, protection in biotechnology,protectionofotherbiologicalmaterials,ownershipandperiodofprotection;National

Biodiversity protection initiatives; Convention on Biological Diversity; InternationalTreatyonPlantGeneticResourcesforFoodandAgriculture;Licensingoftechnologies,Materialtransferagreements,ResearchcollaborationAgreement,LicenseAgreement.

SuggestedReadings

- ErbischFHandMarediaK.1998.*IntellectualPropertyRightsinAgriculturalBiotechnology*.CABI.
- GanguliP.2001.*IntellectualPropertyRights:UnleashingKnowledgeEconomy*.McGraw-Hill.

- *IntellectualPropertyRights:KeytoNewWealthGeneration*.2001.NRDCand AestheticTechnologies.
- MinistryofAgriculture,GovernmentofIndia.2004.*StateofIndianFarmer*.Vol. V.TechnologyGenerationandIPRIssues.AcademicFoundation.
- RothschildMandScottN.(Ed.).2003.*IntellectualPropertyRightsinAnimalBreedingandGenetics*.CABI.
- SahaR.(Ed.).2006.*IntellectualPropertyRightsinNAMandOtherDeveloping Countries:ACompendiumonLawandPolicies*.DayaPubl.House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; TrademarksAct,1999;TheCopyrightAct,1957andamendments;LayoutDesign Act,2000;PPVandFRAct2001,andRules2003;TheBiologicalDiversityAct,2002.

I. Course Title : Experimental Designs

II. Course Code : MCA505

III. Credit Hours : 2+1

IV. Need of the course

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

V. Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

VI. Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law,

Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,

- Analysis with missing data,
- Split plot and strip plot designs.

VII. Suggested Reading

- Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
- Federer WT. 1985. *Experimental Designs*. MacMillan.
- Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
- Pearce SC. 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley.

SECOND SEMESTER

- **CourseTitle :ProductionofWarmSeasonVegetableCrops**
- **CourseCode :HOR 506**
- **CreditHours :(2+1)**
- **Need of thecourse?**

  Unlikecool-seasonvegetables,warm-seasonvegetablecropsrequire higher soiland air temperature, thus, they are always planted after the last frost date rangingfromlatespringafterthelastfrostdatetolatesummer.Daytimetemperatur emay still be warm enough but drop so much at night-time that the weather is notsuitableforwarm-seasoncropsanylonger.Ingeneralsummervegetablesrequirea little higher temperature than winter vegetables for optimum growth. In summervegetables, the edible portion is mostly botanical fruit. The students of vegetablescience need to have an understanding of production technology of important warmseasonvegetablecropsandthereaftertheirmanagement.

- **Objectofthecourse**

  To impart knowledge and skills on advancement in production technology of warmseasonvegetablecrops

  Thecourseisconstructedgivenasunder:

No.	Block	Unit
•	Productionofwarmseasonvegetable blescrops	1.Fruitvegeta 2.Beans • Cucurbits • Tubercrops • Leafyvegetables

- **Theory**

  Introduction, commercial and nutritional importance, origin and distribution, botanyand taxonomy, area, production, productivity and constraints, soil requirements,climaticfactorsforyieldandquality,commercialvarieties/hybrids, seedrateand

  seed treatment, raising of nursery including grafting technique, sowing/ plantingtimeandmethods,precisionfarming,croppingsystem,nutritionalincludi

ngmicronutrientsandirrigationrequirements,interculturaloperations,specialho rticultural practices namely hydroponics, aeroponics, weed control, mulching,roleofplantgrowthregulators,physiologicaldisorders,maturityindice s,harvesting,yield,post-harvestmanagement(grading,packagingandmarking),pestanddiseasemanage mentandeconomicsofcrops.

UnitI

Fruitvegetables—Tomato,brinjal,hotpepper,sweetpepperandokra.

UnitII

Beans—Frenchbean,Indianbean(Sem),clusterbeanandcowpea.

UnitIII

Cucurbits—Cucumber,melons,gourds,pumpkinandsquashes.

UnitIV

Tubercrops—Sweetpotato,elephantfootyam,tapioca,taroandyam.

UnitV

Leafyvegetables—Amaranthanddrumstick.

- **Practical**
  - Scientificraisingofnurseryandseedtreatment;
  - Sowing,transplanting,vegetablegrafting;
  - Description of commercial varieties and hybrids;
  - Demonstrationonmethodsofirrigation,fertilizersandmicronutrientsapplication;
  - Mulchingpractices,weedmanagement;
  - Useofplantgrowthsubstancesinwarmseasonvegetablecrops;
  - Studyofnutritionalandphysiologicaldisorders;
  - Studiesonhydroponics,aeroponicsandothersoillessculture;
  - Identificationofimportantpestanddiseasesandtheircontrol;
  - Preparationofcroppingschemeforcommercialfarms;
  - Visittocommercialfarm,greenhouse/polyhouses;
  - Visittovegetablemarket;
  - Analysisofbenefittocostratio.
- **TeachingMethods/Activities**
  - ClassroomLectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontrainingofdifferentprocedures
  - Groupdiscussion
- **Learningoutcome**

Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:

- Appreciatethescopeandscenarioofwarmseasonvegetablecropsin India
- Acquireknowledgeabouttheproductiontechnologyandpost-harvesthandlingofwarmseasonvegetablecrops
- Calculatetheeconomicsofvegetableproductionin India

SuggestedReading

BoseTK,KabirJ,MaityTK,ParthasarathyVAandSomMG.2003.*Vegetablecrops*.Vols.I-III.Nayaudyog.

BoseTK, Som MG and Kabir J. (Eds.). 1993.*Vegetablecrops*. Naya prokash.

ChadhaKLandKallooG.(Eds.).1993-94.*Advancesinhorticulture*Vols.V-X.Malhotrapubl.house.

ChadhaKL.(Ed.).2002.*Handbookofhorticulture*.ICAR.

ChauhanDVS.(Ed.).1986.*VegetableproductioninIndia*.Ramprasadandsons.

FageriaMS,ChoudharyBRandDhakaRS.2000.*Vegetablecrops:productiontechnology*.Vol. II.Kalyani.

GopalakrishananTR.2007.*Vegetablecrops*.NewIndiapubl.agency.

HazraPandBanerjeeMKandChattopadhyayA.2012.*Varietiesofvegetablecrops inIndia*,(Secondedition),Kalyanipublishers,Ludhiana,199p.

HazraP.2016.*Vegetablescience*. 2ndedn,Kalyanipublishers,Ludhiana.

HazraP.2019.*Vegetableproductionandtechnology*.NewIndiapublishingagency,New Delhi.

HazraP,ChattopadhyayA,KarmakarKandDuttaS.2011.*Moderntechnologyforvegetableproduction*,NewIndiapublishingagency,NewDelhi,413p

RanaMK.2008.*OlericultureinIndia*.KalyaniPublishers,NewDelhi.

RanaMK.2008.*Scientificcultivationofvegetables*.KalyaniPublishers,NewDelhi.

RubatzkyVEandYamaguchiM.(Eds.).1997.*Worldvegetables:principles,productionandnutritivevalues*.ChapmanandHall.

SainiGS.2001.*Atextbookofoleriandfloriculture*.Amanpublishinghouse.

SalunkheDKandKadamSS.(Ed.).1998.*Handbookofvegetablescienceandtechnology:production,composition,storageandprocessing*.Marceldekker.

ShanmugaveluKG.,1989.*Productiontechnologyofvegetablecrops*.OxfordandIBH.

SinghDK.2007.*Modernvegetablevarietiesandproductiontechnology*.International bookdistributingCo.

SinghSP.(Ed.).1989.*Productiontechnologyofvegetablecrops*.Agril.comm.res.centre.Thamburaj S and Singh N. (Eds.). 2004. *Vegetables, tuber crops and spices*.

ICAR.ThompsonHCandKellyWC.(Eds.).1978.*Vegetablecrops*.TataMcGraw-Hill.

- **CourseTitle :SeedProductionofVegetableCrops**
- **CourseCode :HOR507**
- **CreditHours :(2+1)**
- **Needof thecourse?**

  Enhancing yield and quality of vegetable crops depends upon a number of factors.The inputs like fertilizers, irrigation and plant protection measures and suitableagronomic practices contribute greatly towards improving yield and quality of thevegetable produce. If good quality seed is not used, the full benefits of such inputsandagronomicpracticescannotberealized.Theuseofhighqualityseedthus, playsa pivotal role in the production of vegetable crops. It is, therefore, important to usethe seed conforming to the prescribed standards. A good quality seed should havehighgeneticandphysicalpurity,propermoisturecontentandgoodgerminati on.It should also be free from seed borne diseases and weed seeds. The quality of theproducewilldeteriorateifthesefactorsareoverlooked.Outcrossing,physicala dmixturesandmutationsaretheprimefactorsresponsibleforthedeteriorationofse edquality.Avarietycouldbesavedfromdeteriorationifproperchecksaremadeat different stages of seed multiplication. It is also extremely important to maintainhigh genetic purity of a variety. The students of vegetable science need to have anunderstanding of seed production technology of vegetable crops and their essentialprocessingbeforesupplyingthemtothemarketorfurtheruse.
- **Objectofthecourse**

  Toimpartacomprehensiveknowledgeandskillsonqualityseedproductionofvege tablecrops

  Thecourseisconstructedgivenasunder:

No.	Block	Unit
•	Seedproductionofvegetablecrops	I. Introduction,history,propagationand reproduction • Agro-climateandmethodsofseedproduction • Seedmultiplicationanditsqual itymaintenance • Seedharvesting,extractionand itsprocessing

- Improvedagro-techniquesandfieldandseedstandards

- **Theory**

UnitI

Introduction,history,propagationandreproduction—Introduction,definitionofseed and its quality, seed morphology, development and maturation; Apomixis and fertilization;Modesofpropagationandreproductivebehaviour;Pollinationmechanismsandsexformsinvegetables;Historyofvegetableseedproduction;Statusandshareofvegetableseedsinseedindustry

UnitII

Agro-climateandmethodsofseedproduction—Agro-climateanditsinfluenceonqualityseedproduction;Deteriorationofcropvarieties,geneticalandagronomicprinciplesofvegetableseedproduction;Methodsofseedproduction,hybridseedsandtechniquesoflargescalehybridseedproduction;Seedvillageconcept

UnitIII

Seedmultiplicationanditsqualitymaintenance—Seedmultiplicationratiosandreplacementratesinvegetables;Generationsystemofseedmultiplication;Maintenanceandproductionofnucleus,breeder,foundation,certified/truthfullabelseeds;Seedqualityandmechanismsofgeneticpuritytesting

UnitIV

Seedharvesting,extractionanditsprocessing—Maturitystandards;Seedharvesting, curingandextraction;Seedprocessing,viz.,cleaning,dryingandtreatmentofseeds,seedhealthandqualityenhancement,packagingandmarketing;Principlesofseedstorage;Orthodoxandrecalcitrantseeds;Seeddormancy

UnitV

Improved agro-techniques and field and seed standards—Improved agro-techniques;Field and seed standards in important solanaceous, leguminous and cucurbitaceousvegetables,colecrops,leafyvegetables,bulbousandrootcropsandokra;clonalpropagationandmultiplicationinvegetativepropagatedcrops;Seedplottechniqueandtruepotatoseedproductioninpotato

- **Practical**
  - Studyoffloralbiologyandpollinationmechanismsinvegetables;
  - Determinationofmodesofpollination;

- Fieldandseedstandards;
- Useofpollinationcontrolmechanismsinhybridseedproductionofimportantvegetables;
- Maturitystandardsandseedextractionmethods;
- Seedsamplingandtesting;
- Visittocommercialseedproductionareas;
- Visittoseedprocessingplant;
- Visittoseedtestinglaboratories.

- **TeachingMethods/Activities**
  - ClassroomLectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontrainingofdifferentprocedures
  - Groupdiscussion

- **Learningoutcome**

  Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:
  - Appreciatethescopeandscenarioofseedproductionofvegetablecropsin India
  - Acquireknowledgeaboutthecompleteseedproductiontechnology,extraction andpost-extractionprocessingofvegetableseeds
  - Adoptionofseedproductionofvegetablecropsasentrepreneur

X.SuggestedReading

AgarwaalPKandAnuradhaV.2018.*Fundamentalsofseedscienceandtechnology*.Brilliantpublications,NewDelhi.

AgrawalPKandDadlaniM.(Eds.).1992.*Techniquesinseedscienceandtechnology*.SouthasianPubl.

AgrawalRL.(Ed.).1997.*Seedtechnology*.OxfordandIBH.

BasraAS.2000.*Hybridseedproductioninvegetables*.CRCpress,Florida,USA.

BenchALRandSanchezRA.2004.*Handbookofseedphysiology*.Foodproductspress,NY/London.

Bendell PE. (Eds.). 1998. *Seedscienceandtechnology:Indianforestryspecies*. Allied

Publ.ChakrabortySK,PrakashS,SharmaSPandDadlaniM.2002.*Testingofdistinctiveness, uniformityandstabilityforplantvarietyprotection*.IARI,NewDelhi

CoplandLOandMcDonaldMB.2004.*Seedscienceandtechnology*,KluwerAcademicPress.FageriaMS,AryaPSandChoudharyAK.2000.*Vegetablecrops:breedingandseedproduction*. Vol.I.KalyaniPublishers,NewDelhi.

GeorgeRAT.1999.*Vegetableseedproduction*(2ndEdition).CABInternational.
KallooG,JainSK,VariAKandSrivastavaU.2006.*Seed:Aglobalperspective*.Associated publishingcompany,NewDelhi.
HazraPandSomHG.2015.*Seedproductionandhybridtechnologyofvegetablecrops*.Kalyanipublishers,Ludhiana.
KumarJCandDhaliwalMS.1990.*Techniquesofdevelopinghybridsinvegetablecrops*.Agrobotanicalpubl.
MoreTA,KalePBandKhuleBW.1996.*Vegetableseedproductiontechnology*.Maharashtrastateseedcorp.
RajanSandMarkoseBL.2007.*Propagationofhorticulturalcrops*.NewIndiapubl.agency.SinghNP,SinghDK,SinghYKandKumarV.2006.*Vegetableseedproductiontechnology*.
InternationalbookdistributingCo.
SinghSP.2001.*Seedproductionofcommercialvegetables*.Agrotechpubl.academy.SinghalNC.2003.*Hybridseedproduction*.Kalyanipublishers,NewDelhi

I. **CourseTitle: Principal and Practices of Soil Fertility and Nutrient Management**

II. **CourseCode :AGR 508**

III. **CreditHours :2+1**

IV. **Ojectiveofthecourse**

To impart knowledge of fertilizers and manures as sources of plant nutrients andapprise about the integrated approach of plant nutrition and sustainability of soilfertility.

V. **Theory**

UnitI

Soil fertility and productivity - factors affecting; features of good soil management;problemsofsupplyandavailabilityofnutrients;relationbetweennutrientsupplyandcropgrowth;organicfarming-basicconceptsanddefinitions.

UnitII

Criteriaofessentialityofnutrients;Essentialplantnutrients–theirfunctions,nutrientdeficiencysymptoms;transformationanddynamicsofmajorplantnutrients.

UnitIII

Preparation and use of farmyard manure, compost, green manures, vermicompost,biofertilizersandotherorganicconcentratestheircompositio

n,availability
andcropresponses;recyclingoforganicwastesandresiduemanagement.Soill esscultivation.

UnitIV

Commercial fertilizers; composition, relative fertilizer value and cost; crop
responsetodifferentnutrients,residualeffectsandfertilizeruseefficiency;agr onomic,chemical and physiological, fertilizer mixtures and grades; methods of increasingfertilizeruseefficiency;nutrientinteractions.

UnitV

Time and methods of manures and fertilizers application; foliar application and
itsconcept;relativeperformanceoforganicandinorganicnutrients;economicsoff ertilizeruse;integratednutrientmanagement;useofvermincompostandresiduew astesincrops.

VI.Practical

- DeterminationofsoilpHandsoilEC
- DeterminationofsoilorganicC
- DeterminationofavailableN,P,KandSofsoil
- DeterminationoftotalN,P,KandSofsoil
- DeterminationoftotalN,P,K,Sinplant
- Computationofoptimumandeconomicyield

VII. Teachingmethods/activities

ClassroomteachingwithAVaids,groupdiscussion,assignmentandclassdiscussion

VIII. Learningoutcome

Basicknowledgeonsoilfertilityandmanagement

IX. SuggestedReading

- BradyNCandWeilRR.2002.TheNatureandPropertiesofSoils.13thEd.PearsonEdu.
- FageriaNK,BaligarVCandJonesCA.1991.GrowthandMineralNutritionofFieldCrops.
  MarcelDekker.
- HavlinJL,BeatonJD,TisdaleSLandNelsonWL.2006.SoilFertilityandFertilizers.7thEd.PrenticeHall.
- PrasadRandPowerJF.1997.SoilFertilityManagementforSustainableAgriculture.CRC
  Press.
- YawalkarKS,AgrawalJPandBokdeS.2000.ManuresandFertilizers.Agri-HortiPubl.

- **CourseTitle :Basic concepts in laboratory techniques**
- **CourseCode :PGS509**
- **CreditHours :0+1**

Objective

Toacquaintthestudentsaboutthebasicsofcommonlyusedtechniquesinlaboratory.

Practical

- SafetymeasureswhileinLab;
- Handlingofchemicalsubstances;
- Useofburettes,pipettes,measuringcylinders,flasks,separatoryfunnel,condensers,micropipettesandvaccupets;
- Washing,dryingandsterilizationofglassware;
- Dryingofsolvents/chemicals;
- Weighingandpreparationofsolutionsofdifferentstrengthsandtheirdilution;
- Handlingtechniquesofsolutions;
- Preparationofdifferentagro-chemicaldosesinfieldandpotapplications;
- Preparationofsolutionsofacids;
- Neutralisationofacidandbases;
- PreparationofbuffersofdifferentstrengthsandpHvalues;

- Useandhandlingofmicroscope,laminarflow,vacuumpumps,viscometer,thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath,oilbath;
- Electricwiringandearthing;
- Preparationofmediaandmethodsofsterilization;
- Seedviabilitytesting,testingofpollenviability;
- Tissueculture ofcropplants;
- Descriptionoffloweringplantsinbotanicaltermsinrelationtotaxonomy.

SuggestedReadings

- FurrAK.2000.*CRCHandBookofLaboratorySafety*.CRCPress.
- GabbMHandLatchemWE.1968.*AHandbookofLaboratorySolutions*.ChemicalPubl.Co.

I. Course Title : Information Technology in Agriculture
II. Course Code : MCA510
III. Credit Hours :1+1
IV. Need of the course

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture

V. 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

765

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

Unit III

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

Unit IV

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

THIRD SEMESTER

- **CourseTitle :Growth and Development of Vegetable Crops**
- **CourseCode :HOR511**
- **CreditHours :(2+1)**
- **Need of thecourse?**

  Inagriculture,thetermplantgrowthanddevelopmentisoftensubstitutedwithcrop growth and yield since agriculture is mainly concerned with crops and their economicproducts. Growth, which is irreversible quantitative increase in size, mass, and/ orvolume of a plant or its parts, occurs with an expenditure of metabolic energy. Plantdevelopmentisanoverallterm,whichreferstovariouschangesthatoccurduri ngitslife cycle. In vegetable crops, development is a series of processes from the initiationof growth to death of a plant or its parts. Growth and development are sometimesused interchangeably in conversation, but in a botanical sense, they describe separateevents in the organization of the mature plant body. The students of vegetable scienceneedtohaveanunderstandingofgrowthanddevelopmentofvegetablecrop s.

- **Objectiveofthecourse**

  Toteachthephysiologyofgrowthanddevelopmentofvegetablecrops

No.	Block	Unit
•	Growthanddevelopmentof phytohormonesvegetablecrops 2.Physiologyofdormancyandgermination	1.Introduction and • Abioticfactors • Fruitphysiology • Morphogenesisandtissueculture

- **Theory**

UnitI

Introductionandphytohormones—
Definitionofgrowthanddevelopment;Cellularstructuresandtheirfunctions;Phy siologyofphyto-
hormonesfunctioning/biosynthesisandmodeofaction;Growthanalysisanditsim portanceinvegetableproduction.

UnitII

Physiologyofdormancyandgermination—
Physiologyofdormancyandgerminationofvegetableseeds,tubersandbulbs;Role ofauxins,gibberellilns,cyktokininsandabscissicacid;ApplicationofsyntheticP GRsincludingplantgrowthretardantsand inhibitors for various purposes in vegetable crops; Role and mode of action ofmorphactins,antitranspirants,anti-auxin,ripeningretardantandplantstimulantsinvegetablecropproduction.

UnitIII

Abioticfactors—
Impactoflight,temperature,photoperiod,carbondioxide,oxygenandothergaseso ngrowth,developmentofundergroundparts,floweringandsexexpressioninveget ablecrops;Apicaldominance.

UnitIV

Fruitphysiology—
Physiologyoffruitset,fruitdevelopment,fruitgrowth,flowerand fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors,senescence and abscission; fruit ripening and physiological changes associated withripening.

UnitV

Morphogenesis and tissue culture—Morphogenesis and tissue culture techniques invegetablecrops;Graftingtechniquesindifferentvegetablecrops.

- **Practical**
  - Preparationofplantgrowthregulator'ssolutionsandtheirapplication;
  - Experimentsinbreakingandinductionofdormancybychemicals;
  - Induction of parthenocarpy and fruit ripening;
  - Application of plant growth substances for improving flower initiation, changingsex expression in cucurbits and checking flower and fruit drops and improvingfruitsetinsolanaceousvegetables;
  - Growthanalysistechniquesinvegetablecrops;
  - Graftingtechniquesintomato,brinjal,cucumberandsweetpepper.
- **TeachingMethods/Activities**
  - ClassroomLectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontrainingofdifferentprocedure
  - Groupdiscussion
- **Learningoutcome**

Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:
- Acquireknowledgeaboutthegrowthanddevelopmentofplantsinvegetablecrops
- Distinguishbetweenprimaryandsecondarygrowthinplantstems
- Understandhowhormonesaffectthegrowthanddevelopmentofvegetablecrops

- **SuggestedReading**

BleasdaleJKA.1984.*Plantphysiologyinrelationtohorticulture*(2ndEdition)MacMillan.GuptaUS.Eds.1978.*Cropphysiology*.OxfordandIBH,NewDelhi.
KallooG.2017.*Vegetablegrafting:Principlesandpractices*.CABInternationalKrishnamoortiHN.1981.*Applicationgrowthsubstancesandtheirusesinagriculture*.Tata McGrawHill,NewDelhi.
LeopoldACandKriedemannPE.1981.*Plantgrowthanddevelopment*,TataMcGraw-Hill,NewDelhi.
PeterKVandHazraP.(Eds).2012.*Handbookofvegetables*.StudiumPressLLC,P.O.Box722200,Houston,Texas77072,USA,678p.
PeterKV.(Eds).2008.
Basicsofhorticulture.NewIndiapublicationagency,NewDelhi.RanaMK.2011.
Physio-biochemistryandBiotechnologyofVegetables.NewIndiaPublishing Agency,PritamPura,NewDelhi.
Saini*etal.*(Eds.).2001.*Laboratorymanualofanalyticaltechniquesinhorticulture*.Agrobios,Jodhpur.

- **CourseTitle :PostharvestManagementofVegetableCrops**
- **CourseCode :HOR512**
- **CreditHours :(2+1)**
- **Need of the course?**

Vegetables are highly perishable crops as they have great quantity and quality lossafterharvest.Hence,theyrequireintegratedapproachtoarresttheir spoilage,which causes tones of vegetable produce annually. Lack of postharvest awarenessand inadequacy of equipment's are the major problems in postharvest chain,whichleadtoaseriouspost-harvestlossinthedevelopingcountrieseveryyear.Acomprehensiveunderstandingofpostharvestfactorscausingdeteriorationisnecessary to overcome these challenges. Pre and postharvest management such asuseofimprovedvarieties,goodculturalpractices,goodpreandpostharvesthandlingpractices, management of temperature, relative humidity and storage atmosphereaccording to crop requirement, use of permitted chemicals, design of appropriatepackagingmaterialandstoragestructuresaresomeofthecontrolmeasuresusedinreducingpostharvestlosses,therefore,thiscoursewascustomized.

- **Objective of the course**

To facilitate deeper understanding of principles and to acquaint the student withproper handling and management technologies of vegetable crops for minimizingthepost-harvestlosses

Thecourseisorganizedasfollows:

No.	Blocks	Units
	• Post-harvestmanagementof vegetablecrops	I Importanceandscope IIMaturityindicesandbiochemistryIIIHarvestingandlossesfactors IVPackinghouseoperations V Methodsofstorage

- **Theory**

UnitI

Importanceandscope—Importanceandscopeofpost-harvestmanagementofvegetables

UnitII

Maturityindicesandbiochemistry—
Maturityindicesandstandardsfordifferentvegetables; Methods of maturity determination; Biochemistry of maturity and ripening; Enzymatic and textural changes; Ethylene evolution and ethylene management;Respirationandtranspirationalongwiththeirregulationmethods

UnitIII

Harvesting and losses factors—Harvesting tools and practices for specific marketrequirement; Postharvest physical and biochemical changes; Preharvest practicesandotherfactorsaffectingpostharvestlosses

Packinghouseoperations—Packinghouseoperations;Commoditypretreatments chemicals, waxcoating, precooling and irradiation; Packaging of vegetables, prevention from infestation, management of postharvest diseases and principles oftransportation

UnitV

Methods of storage—Ventilated, refrigerated, modified atmosphere and controlledatmosphere storage, hypobaric storage and cold storage; Zero-energy cool chamber,storagedisorderslikechillinginjuryinvegetables

- **Practical**
  - Studiesonstagesandmaturingindices;
  - Ripeningofcommerciallyimportantvegetablecrops;
  - Studiesofharvesting,pre-cooling,pre-treatments,physiologicaldisorders-chillinginjury;
  - Improvedpackaging;
  - Useofchemicalsforripeningandenhancingshelflifeofvegetables;
  - Physiologicallossinweight,estimationoftranspiration,respirationrateandethylenerelease;
  - Storageofimportantvegetables;

- Coldchainmanagement;
- Visittocommercialpackinghouse,coldstorageandcontrolatmospherestorage.

- **Teaching Methods/Activities**
  - Classroomlecturesincludingppt.
  - Studentsgroupdiscussion
  - Individualorgroupassignments(writingandspeaking)
  - Presentationofpracticalhandwork

- **Learning outcome**

  Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedtobeabletound erstand:
  - Regulationofpostharvestlossesbyusingchemicalsandgrowthregulators
  - Preandpostharvesttreatmentsforextendingshelflifeofvegetablecrops
  - Packinghouseoperationsforextendingtheshelflifeofvegetablecrops
  - Successfulstorageofvegetablecrops

- **SuggestedReading**

ChadhaKLandPareekOP.1996.*Advancesinhorticulture*.Vol.IV.MalhotraPubl.House.
ChattopadhyaySK.2007.*Handling,transportationandstorageoffruitandvegetables*.Gene-
Techbooks,NewDelhi.
HaidNFandSalunkheSK.1997.*Postharvestphysiologyandhandlingoffruitsandvegetables*.
GrenadaPubl.
MitraSK.1997.*Postharvestphysiologyandstorageoftropicalandsub-tropicalfruits*.CABI.PaliyathG,MurrDP,HandaAKandLurieS.
2008.*Postharvestbiologyandtechnologyof*
Fruits,vegetablesandflowers.Wiley-Blackwell,ISBN:9780813804088.
RangannaS.1997.*Handbookofanalysisandqualitycontrolforfruitandvegetableproducts*.
TataMcGraw-Hill.
StawleyJK.1998.
Postharvestphysiologyofperishableplantproducts.CBSpublishers.SudheerKP andIndiraV.2007.*Postharvesttechnologyofhorticulturalcrops*.NewIndiaPubl.
Agency.

2)BlackwellPublishingLtd,Oxford,UK.ISBN:9781118654040.
VermaLR and JoshiVK. 2000. *Postharvesttechnologyoffruitsandvegetables:handling,processing, fermentation and waste management*. Indus Publishing Company, New Delhi,India.ISBN8173871086.

Willis R, McGlassen WB, Graham D and Joyce D. 1998. *Postharvest: An introduction to thephysiologyandhandlingoffruits,vegetablesandornamentals*.CABI.

Wills RBH and Golding J. 2016. *Postharvest: an introduction to the physiology and handling offruitandvegetables*,CABIPublishing,ISBN9781786391483.

Wills RBH and Golding J. 2017. *Advances in postharvest fruit and vegetable technology*, CRCPress,ISBN9781138894051.

I. **CourseTitle :Principles and Practices of Water Management**

II. **CourseCode :AGR 513**

III. **CreditHours :2+1**

IV. **Aimofthecourse**

Toteachtheprinciplesofwatermanagementandpracticestoenhancethewaterproductivity

V. **Theory**

UnitI

Waterandits roleinplants;Irrigation:Definitionandobjectives,waterresourcesand irrigation development in of India and concerned state, major irrigation projects,extentofarea andcropsirrigated inIndiaand indifferentstates.

UnitII

Field water cycle, water movement in soil and plants; transpiration; soil-water-plantrelationships;waterabsorptionbyplants;plantresponse to water stress,cropplantadaptationtomoisturestresscondition.Wateravailabilityand itsrelationshipwithnutrientavailabilityandloses.

UnitIII

Soil, plant and meteorological factors determining water needs of crops, scheduling,depthandmethodsofirrigation;microirrigationsystems;deficitirrigation;fertigation;managementofwaterincontrolledenvironmentsandpolyhouses. Irrigationefficiencyandwateruseefficiency.

UnitIV

Water management of crop and cropping system, Quality of irrigation water andmanagementofsalinewaterforirrigation,wateruseefficiency,Cropwaterrequirement- estimation of ET and effective rainfall; Water management of themajorcropsandcroppingsystems.Automatedirrigationsystem.

UnitV

Excessofsoilwaterandplantgrowth;watermanagementinproblemsoils,drai

nagerequirement of crops and methods of field drainage, their layout and spacing; rainwatermanagementanditsutilizationforcropproduction.

UnitVI

Quality of irrigation water and management of saline water for irrigation, watermanagementinproblemsoils

UnitVII

Soilmoistureconservation,waterharvesting,rainwatermanagementanditsutilizationforcropproduction.

UnitVIII

Hydroponics,

UnitIX

Watermanagementofcropsunderclimatechangescenario.

VI. Practical

- DeterminationofFieldcapacitybyfieldmethod
- DeterminationofPermanentWiltingPointbysunflowerpotculturetechnique
- DeterminationofFieldcapacityandPermanentWiltingPointbyPressurePlateApparatus
- DeterminationofHygroscopicCoefficient
- Determinationofmaximumwaterholdingcapacityofsoil
- Measurementofmatricpotentialusinggaugeandmercurytypetensiometer
- Determinationofsoil-moisturecharacteristicscurves
- Determinationofsaturatedhydraulicconductivitybyconstantandfallingheadmethod
- Determinationofhydraulicconductivityofsaturatedsoilbelowthewatertablebyaugerholemethod
- Measurementofsoilwaterdiffusivity
- Estimationofunsaturatedhydraulicconductivity
- Estimationofupwardfluxofwaterusingtensiometerandfromdepthgroundwatertable
- Determinationofirrigationrequirementofcrops(calculations)
- Determinationofeffectiverainfall(calculations)
- DeterminationofETofcropsbysoilmoisturedepletionmethod16.Determinationofwaterrequirementsofcrops
- Measurementofirrigationwaterbyvolumeandvelocity-areamethod
- Measurementofirrigationwaterbymeasuringdevicesandcalculationofirrigationefficiency
- Determinationofinfiltrationratebydoubleringinfiltrometer

VII. Teachingmethods/activities

ClassroomteachingwithAVaids,groupdiscussion,assignmentandfieldvisit

VIII. Learningoutcome

Basicknowledgeonwatermanagementforoptimizationofcropyield

IX. SuggestedReading

- MajumdarDK.2014.IrrigationWaterManagement:PrinciplesandPractice.P

HLLearningprivatepublishers
- MukundJoshi.2013.ATextBookofIrrigationandWaterManagementHardcover,Kalyanipublishers
- LenkaD.1999.IrrigationandDrainage.Kalyani.
- MichaelAM.1978.Irrigation:TheoryandPractice.VikasPubl.
- PaliwalKV.1972.IrrigationwithSalineWater.IARIMonograph,NewDelhi.
- PandaSC.2003.PrinciplesandPracticesofWaterManagement.Agrobios.
- PriharSSandSandhuBS.1987.IrrigationofFoodCrops-PrinciplesandPractices.ICAR.
- ReddySR.2000.PrinciplesofCropProduction.Kalyani.
- SinghPratapandMaliwalPL.2005.TechnologiesforFoodSecurityandSustainableAgriculture.AgrotechPubl.

CourseTitle :Technical writing and communications skills
CourseCode. :PGS514
CreditHours :0+1

Objective

To equip the students/ scholars with skills to write dissertations, research papers,etc. To equip the students/ scholars with skills to communicate and articulate inEnglish(verbalaswellaswriting).

Practical(TechnicalWriting)

- Various forms of scientific writings- theses, technical papers, reviews, manuals,etc.;
- Variouspartsofthesisandresearchcommunications(titlepage,authorshipcontentspage,preface,introduction,reviewofliterature,materialandmethods,experimentalresultsanddiscussion);
- Writingofabstracts,summaries,précis,citations,etc.;
- Commonly usedabbreviationsinthethesesandresearchcommunications;
- Illustrations,photographsanddrawingswithsuitablecaptions;pagination,numberingoftablesandillustrations;
- Writingofnumbersanddatesinscientificwrite-ups;
- Editingandproof-reading;
- Writingofareviewarticle;
- CommunicationSkills-Grammar(Tenses,partsofspeech,clauses,punctuationmarks);
- Erroranalysis(Commonerrors),Concord,Collocation,Phoneticsymbolsandtranscription;
- Accentualpattern:Weakformsinconnectedspeech;
- Participationingroupdiscussion;

- Facinganinterview;
- Presentationofscientificpapers.

Suggested Readings

- BarnesandNoble.RobertC.(Ed.).2005.*SpokenEnglish:FlourishYourLanguage.*
- *ChicagoManualofStyle.*14thEd.1996.PrenticeHallofIndia.
- *Collins'CobuildEnglishDictionary.*1995.
- Harper Collins. Gordon HMand Walter JA. 1970.*TechnicalWriting.*3rdEd.
- Holt,RinehartandWinston.HornbyAS.2000.*Comp.OxfordAdvancedLearner'sDictionaryofCurrentEnglish.*6thEd.OxfordUniversityPress.
- JamesHS.1994. *HandbookforTechnicalWriting.*NTCBusinessBooks.
- JosephG.2000.*MLAHandbookforWritersofResearchPapers.*5thEd.AffiliatedEast-WestPress.
- MohanK.2005.*SpeakingEnglishEffectively.*MacMillanIndia.
- RichardWS.1969.*TechnicalWriting.*
- SethiJandDhamijaPV.2004.*CourseinPhoneticsandSpokenEnglish.*2ndEd. PrenticeHallofIndia.
- WrenPCandMartinH.2006.*HighSchoolEnglishGrammarandComposition.* S.Chand&Co.

CourseTitle :Agricultural research, research ethics and rural development programmes

CourseCode :PGS515

CreditHours :1+0

Objective

To enlighten the students about the organization and functioning of agriculturalresearch systems at national and international levels, research ethics, and ruraldevelopmentprogrammesandpoliciesofGovernment.

Theory

UNIT I History of agriculture in brief; Global agricultural research system: need,scope, opportunities; Role in promoting food security, reducing poverty and protectingthe environment; National Agricultural Research Systems (NARS) and RegionalAgriculturalResearchInstitutions;ConsultativeGrouponInternational AgriculturalResearch(CGIAR):InternationalAgriculturalResearchCentres(IARC),partnershipwithNARS,roleasapartnerintheglobalagriculturalresearchsystem,strengthening capacities at national and regional levels; International fellowshipsforscientificmobility.

UNIT II Research ethics: research integrity, research safety in laboratories, welfareof animals used in research, computer ethics, standards and problems in researchethics.

UNIT III Concept and connotations of rural development, rural development policiesandstrategies.Ruraldevelopmentprogrammes:CommunityDevelopme ntProgramme,IntensiveAgriculturalDistrictProgramme,Specialgroup–AreaSpecificProgramme,IntegratedRuralDevelopmentProgramme(IRDP)Pan chayatiRajInstitutions,Co-operatives,VoluntaryAgencies/Non-GovernmentalOrganisations.Criticalevaluationofruraldevelopmentpoliciesa ndprogrammes.Constraintsinimplementationofruralpoliciesandprogrammes.

Suggested Readings

- BhallaGSandSinghG.2001.*IndianAgriculture-FourDecadesofDevelopment*.SagePubl.
- PuniaMS.*ManualonInternationalResearchandResearchEthics*.CCSHarya naAgriculturalUniversity,Hisar.
- RaoBSV.2007.*RuralDevelopmentStrategiesandRoleofInstitutions-Issues,InnovationsandInitiatives*.MittalPubl.
- SinghK.1998.*RuralDevelopment-Principles,PoliciesandManagement*.SagePubl.

FOURTH SEMESTER

- **CourseTitle :PrinciplesofVegetableBreeding**
- **CourseCode :HOR516**
- **CreditHours :(2+1)**
  - **Need of thecourse?**

Plant breeding has been practiced for thousands of years, since beginning of humancivilization.Vegetablebreeding,whichisanartandscienceofchangingthetraitsofplantsinordertoproducedesiredtraits,hasbeenusedtoimprovethequalityof nutrition in products for human beings. A breeding programme, which is neededifcurrentvarietiesarenotproducinguptothecapacityoftheenvironment,can be accomplished through many different techniques ranging from simply selectingplants with desirable characteristics, make use of knowledge of genetics and chromosomestomorecomplexmoleculartechniques.Whendifferentgenotypes exhibit differential responses to different sets of environmental conditions, a genotype x environment (GxE) interaction is said to occur. Breeding high yieldingopenpollinatedvarietiesandhybrids,andexploitationoflocationspecific componentof genotypic performance are the only options left to reduce this increasing gapbetween the production and requirements in view of decreasing land resources.Nevertheless, vegetable breeding is an integral part of plant breeding but this willbe re-modeled to suit to breeding of different vegetables crops. The students ofvegetablesciencewhoarehavingbreedingasmajorsubjectneedtohaveanunderstandingofvegetablebreedingprinciples.

- **Objectiveofthecourse**

Toteachbasicprinciplesandpracticesofvegetablebreeding

No.	Block	Unit
	• Principlesofvegetablebreeding	I. Importanceandhistory • Selectionprocedures • Heterosis breeding • Mutationbreeding • Polyploidbreeding • Ideotypebreeding

- **Theory**

UnitI

Importance and history- Importance, history and evolutionary aspects of vegetablebreedinganditsvariationfromcerealcropbreeding.

UnitII

Selection procedures- Techniques of selfing and crossing; Breeding systems andmethods;Selectionproceduresandhybridization;Geneticarchitecture;Breed ingfor biotic stress (diseases, insect pests and nematode), abiotic stress (temperature,moisture and salt) resistance and quality improvement; Breeding for water useefficiency(WUE)andnutrientsuseefficiency(NUE).

UnitIII

Heterosisbreeding-
Types,mechanismsandbasisofheterosis,facilitatingmechanismslikemalesterili ty,self-incompatibilityandsexforms.

UnitIV

Mutation and Polyploidy breeding; Improvement of asexually propagated vegetablecropsandvegetablessuitableforprotectedenvironment.

UnitV

Ideotypebreeding-
Ideotypebreeding;varietalreleaseprocedure;DUStestinginvegetablecrops;App licationof*In-vitro*andmoleculartechniquesinvegetableimprovement.

- **Practical**
  - Floralbiologyandpollinationbehaviourofdifferentvegetables;
  - Techniquesofselfingandcrossingofdifferentvegetables,viz.,Colecrops,okra, cucurbits,tomato,eggplant,hotpepper,etc.;
  - Breedingsystemandhandlingoffilialgenerationsofdifferentvegetables;
  - Exposuretobiotechnologicallabpractices;
  - Visittobreedingfarms.
- **TeachingMethods/Activities**
  - ClassroomLectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontrainingofdifferentprocedures
  - Groupdiscussion

Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:

- Acquireknowledgeabouttheprinciplesofvegetablebreeding
- Improveyield,quality,abioticandbioticresistance,otherimportanttraitsofveg etablecrops
- Understandhowthebasicprinciplesareimportanttostartbreedingofvegetablec rops

X.SuggestedReading

AllardRW.1960.*Principleofplantbreeding*.JohnWilleyandSons,
USA.KallooG.1988.*Vegetablebreeding*(Vol.I,II,III).CRCPress,
Fl,USA.

KoleCR.2007.*Genomemappingandmolecularbreedinginplants-vegetables*.Springer,USA.PeterKVandPradeepKumarT.1998.Geneticsandbreedingofvegetables.ICAR,NewDelhi,p. 488.
ProhensJandNuezF.2007.*Handbookofplantbreeding-vegetables*(VolIandII).Springer,USA.
SinghBD.2007.*Plantbreeding-principlesandmethods*(8thedn.).KalyaniPublishers,NewDelhi.
SinghRamJ.2007.*Geneticresources,chromosomeengineering,andcropimprovement-vegetablecrops*(Vol.3).CRCPress,Fl,USA.

I. Course Title : Library and information services
II. Course Code : PGS 517
III. Credit Hours : (0+1)

Objective

Toequipthelibraryuserswithskillstotraceinformationfromlibrariesefficiently,toapprisethemofinformationandknowledgeresources,tocarryoutliteraturesurvey, to formulate information search strategies, and to use modern tools (Internet,OPAC,searchengines,etc.)ofinformationsearch.

Practical

Introduction to library and its services; Role of libraries in education, research andtechnologytransfer;Classificationsystemsandorganizationoflibrary;Sourcesofinformation-PrimarySources,SecondarySourcesandTertiarySources;Intricaciesofabstractingandindexingservices(ScienceCitationIndex,BiologicalAbstracts,Chemical Abstracts,CABIAbstracts,etc.);Tracinginformationfromreferencesources;Literaturesurvey;Citationtechniques/Preparationofbibliography;UseofCD-ROMDatabases,OnlinePublicAccessCatalogueandothercomputerizedlibraryservices;UseofInternetincludingsearchenginesanditsresources;e-resourcesaccessmethods.

Seminar 0+1

Thesis Research 30